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ANNALS *of* SURGERY

Vol. XCVII JANUARY, 1933 No. 1

CYSTICERCUS OF THE BRAIN

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and

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Human infestation by *Tænia solium*, the pork tapeworm, is dangerous, not so much as a result of the gastro-intestinal manifestations, as from the likelihood of cysticercus invasion of various organs of the body which often proves fatal.[1] Although cysticercus in man is not uncommon in many European and other foreign countries, it is fortunate that the disease is but rarely seen in the United States.

The adult parasite, or *Tænia solium*, was known by the ancients,[2] and the cysticercus stage has been known since 1558.[3] It was not, however, until the middle of the nineteenth century that the relationship between *cysticercus cellulosæ* of pigs and the tapeworm of man was first demonstrated.

Morphologically, the tapeworm averages from two to three metres in length. The head is bulbous in appearance and contains four rounded sucking discs.[4] Above the suckers is a projection or rostellum with a double row of horny hooklets varying from twenty-two to thirty-two in number, but averaging usually from twenty-six to twenty-eight.[5] By means of these hooklets the parasite attaches itself to the intestinal mucosa. Below the long, thin neck begin the segments or proglottides, averaging about eight hundred to nine hundred in number. Each segment contains a separate uterus from which a genital pore leads to the surface. The segments of the worm ripen from below upwards, are detached when mature, and are passed from the intestinal canal.

Although the domestic pig is the most frequent carrier of the disease, having the cysticercus usually in the intramuscular connective tissue, it is also found in the sheep, stag, brown bear, dog, cat and monkey. Kuchenmeister (1855), Humbert (1856), Leuckart (1856), Hollenbach (1859), and Heller (1876) have proved that the *cysticercus cellulosæ* of the pig, if introduced into the intestine of man, grows to a *Tænia solium*.[2] In the larval stage, the parasite appears as a small, rounded, nodular, thick-walled cyst from 6 to 20 millimetres in diameter. The outer, tough, fibrous capsule is formed entirely by the host in an effort to wall off or encapsulate the parasite. Immediately within this capsule is a delicate, thin membrane belonging to the embryo proper, and containing thin, watery fluid. When ex-

amined microscopically, the embryo is seen to have a head possessing four rudimentary suckers and a double row of hooklets, resembling the head of the adult parasite. From the time the ovum is introduced into the stomach until the cysticercus is fully developed requires about three months.

Infection by the cysticercus may take place by the ingestion of the ova on contaminated articles of food, by auto-infection in an individual carrying the *Tænia solium* in the intestine by uncleanliness in toilet habits, or by regurgitation from the intestine into the stomach by reverse peristalsis from vomiting. The parasite passes through the wall of the stomach by use of the hooklets, probably entering the blood-stream and being disseminated to all parts of the body. The organs most frequently invaded are the eyes, brain and spinal cord, including the meninges, the muscles, skin and subcutaneous tissue.

In the present paper two cases of cysticercus of the brain are reported; one, a solitary cyst producing a secondary type of hydrocephalus and sudden death; the other, a generalized infection of one cerebral hemisphere, producing the symptoms of brain tumor.

Case I.—N. A., male, aged twenty-three years, was admitted to the University of Michigan Hospital as an emergency case in a semi-comatose condition. Three days previously he had complained of headache which became progressively worse. Nausea and attacks of projectile vomiting occurred the second day. On the third day, when drowsiness and mental confusion accompanied the increasing severity of the headache, he went to bed and summoned his family physician. Shortly thereafter he became quite stuporous and was removed on the following day to the hospital.

Upon arrival he appeared drowsy, and, although disoriented as to time and place, he responded correctly to some questioning. The pupils were equal, regular, and reacted readily to light and in accommodation. Except for a bilateral sixth cranial nerve weakness the extraocular movements were normal. The remaining cranial nerves were intact. There was no mystagmus nor strabismus. The ocular fundi were somewhat hyperæmic but there was no actual choking of the optic discs. The tendon reflexes were active but equal on the two sides. Ankle clonus was well sustained bilaterally. There was no patellar clonus. The Babinski and other pyramidal tract signs were not elicited. Sense of motion and position of the toes was retained. There were no atrophies, deformities, paralyses nor muscle tremors. Neither was there evidence of any ataxia or adiadokokinesis. The objective sensory examination was entirely negative. The temperature and respirations were normal. The pulse rate was 92 per minute.

Shortly after admission, the patient began to have generalized muscular twitchings followed by severe convulsions. A few moments later his pulse could not be obtained and respirations ceased. Attempts to revive him were futile.

The post-mortem examination showed a marked internal hydrocephalus, produced by a spherical, thin-walled, cystic tumor blocking the posterior part of the third ventricle. The cyst measured 2 centimetres in diameter and was suspended from the ventricular roof. Both lateral and third ventricles were greatly dilated. The brain was very œdematous but no evidence of degeneration was present. The remainder of the examination showed nothing of interest.

Microscopical studies proved the tumor to be a cysticercus cyst showing characteristic budding cells but no hooklets. Its origin was probably the choroid plexus. No evidence of the infestation was found elsewhere in the body.

Case II.—M. B., female, aged seventeen years, was admitted on September 3, 1931,

FIG. 1.—Frontal röntgenogram demonstrating diastasis of lambdoidal and sagittal sutures. (Case II.)

to the University of Michigan Hospital complaining of headache, dizziness, failing vision and backache. Two months before, she had developed a sore throat followed by chills and fever, headache, and pain in the back. These symptoms persisted for one week. Her family physician advised a tonsillectomy which was done. There was no improvement. Her vision then became noticeably impaired, and the headaches, which were localized to the frontal and occipital regions, grew much worse. The visual disturbance progressed rapidly. About two weeks before admission she began having attacks of numbness and twitching of the right arm and the right side of her face. Vertigo was also frequent. There had been no gastro-intestinal symptoms.

The patient was born and reared in Austria, having emigrated to the United States

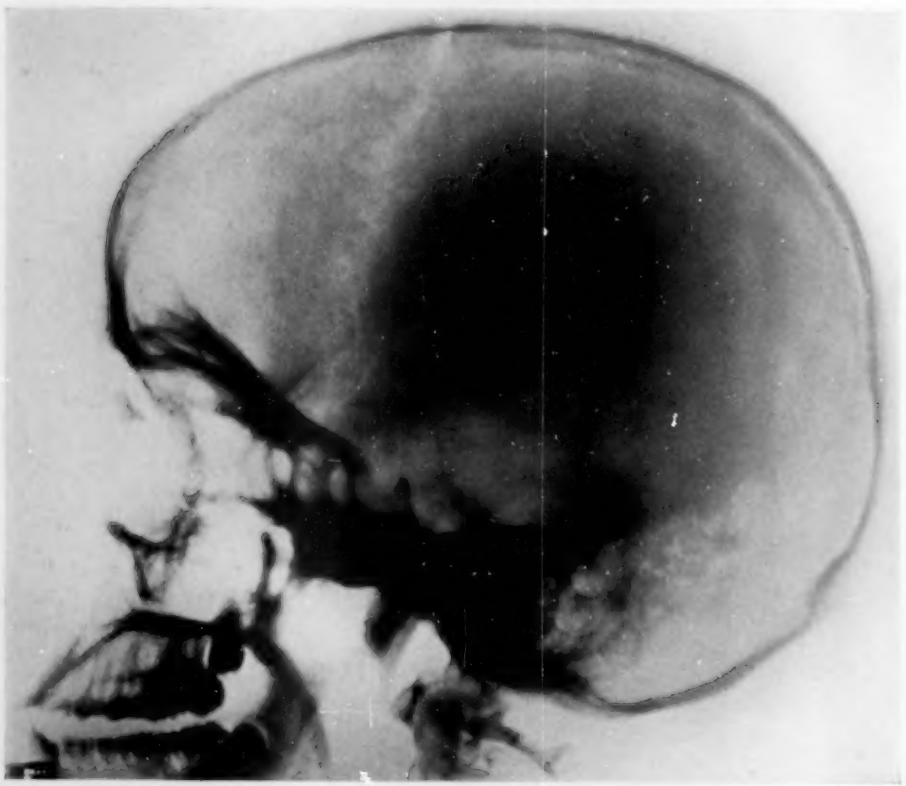

FIG. 2.—Lateral röntgenogram demonstrating diastasis of coronal and lambdoidal sutures without evidence of a localized lesion. (Case II.)

only five months before coming to the hospital. Her health had always been good until the onset of this illness. The family history was irrelevant.

The girl was able to speak but little English. She seemed, however, intelligent and coöperative. The skin and appendages were normal. The palpebral fissures were equal. The pupils were equal and reacted normally to light and in accommodation. The extraocular movements were normal except for nystagmus on lateral deviation of the eyes to the left. The nystagmus was more pronounced in the left than the right eye. The corneal reflexes were active. A papillœdema of four diopters was measured in each eye. There was no facial weakness and the tongue protruded in the mid-line without tremor. The tendon reflexes were more active on the right than the left side. The umbilical reflexes were absent on the right. Occasionally suggestive pyramidal tract signs could be elicited in the right lower extremity. These were never definite

nor constant. There were no other pathological reflexes. Evidence of dysmetria, ataxia, astereognosis, or adiadokokinesis was lacking. There were no sensory changes. Sense of motion and position of the toes was unimpaired. Vibratory sensation was felt better at the left than the right ankle.

Röntgenograms of the skull showed diastasis of all sutures, but no evidence of a localized lesion. (Figs. 1 and 2.) X-rays of the chest were normal.

Urinalysis was repeatedly negative, as was the Kahn reaction on the blood. There were 4,840,000 red blood cells per cubic millimetre and 9,700 white cells. The hæmoglobin was 70 per cent. (Sahli). The differential blood examination revealed 79 per cent. polymorphonuclear neutrophiles, 2 per cent. eosinophiles, 17 per cent. small and 2 per cent. large lymphocytes.

After making a diagnosis of an intracranial lesion localized to the left fronto-parietal region, an osteoplastic flap was turned. The dura, although normal in appearance, was found to be under considerably increased pressure. When the middle meningeal artery was clipped and the dura opened, the brain immediately herniated through. A dural flap was turned with its base upwards. The brain was markedly congested, felt quite hard and firm, and had the appearance of a gliosis rather than of softening, which is usually found with tumor. Several small, hard, shot-like bodies were found in the post-central gyrus. These were excised and found to be small, thick-walled cysts. Many others were then located throughout the cortex by palpation and were also excised. The appearance was that of cysticercosis of the brain. (The report from the pathologist substantiated the diagnosis.) A large subtemporal decompression was made, the bone flap returned to position, and the wound closed.

Following the operation the patient was almost immediately relieved of headaches. Her convalescence was uneventful. The papillœdema subsided and her vision improved greatly. Before discharging her home, further blood studies were made without revealing anything additional. Repeated stool examination showed no evidence of the adult parasite or its ova.

The cases demonstrate the two usual types of the infective process; the first, a solitary cyst, producing symptoms only by obstruction of the aqueduct of Sylvius; the second, a generalized cysticercosis of the cerebrum, probably present on the right side of the brain as well as on the left, but producing signs and symptoms indicative of a tumor of the left fronto-parietal region. Had the cyst been in some other portion of the ventricular system in the first instance, it might never have produced any symptoms. The secondary type of hydrocephalus and sudden death resulted from the location rather than the character of the intraventricular tumor. One could at best in this case only suspect the probability of cysticercus.

When the embryo finally reaches its destination in the tissues a definite inflammatory reaction occurs. There is an infiltration of cells, chiefly lymphocytes, around the embryo, an increase in the vascularization, and, if the lesion is within the central nervous system, a proliferation of glia. This produces within the brain a rather severe œdema—especially if a number of the cysticerci are present—with the resulting symptoms of increased intracranial pressure. Fibroblasts from the blood-vessels and many large multinucleated or monster glia cells make their appearance, gradually forming a connective-tissue capsule or wall around the parasite, and a dense gliosis immediately surrounding the capsule.[6] (Figs. 3 and 4.) At about the end of the third month when the embryo is fully developed, the inflammation

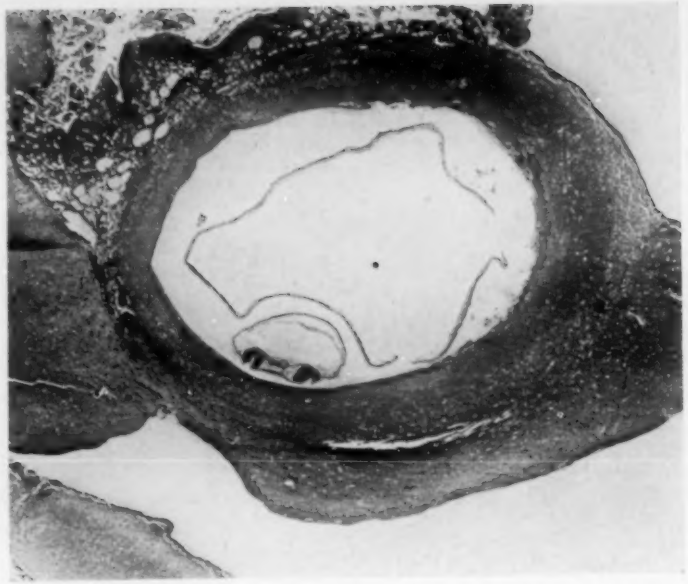

FIG. 3.—Section of Cysticercus (Case II) showing head, rudimentary suckers, membranous lining, and dense connective-tissue capsule. Hæmatoxylin and eosin x 16.

FIG. 4.—Section showing various portions of the larva and the dense glial reaction immediately surrounding the connective-tissue wall of the cyst. Hæmatoxylin and eosin x 16.

begins to subside. The glial reaction, which is rather dense, subsides somewhat also, and the astrocytes assume a more normal appearance with fewer of the monster cells being present. The end-result is a dense, tough, connective tissue capsule entirely surrounding the parasite and seeming a part of it, and in addition a glial scar surrounding the immediate neighborhood of the cyst. If the parasite is shelled from its host, the connective-tissue capsule remains attached to it, suggesting erroneously that the capsule is a part of the parasite rather than of the host. The cysts in themselves are but slightly toxic.

During the stages when the cerebral œdema is most severe, the intracranial pressure is often quite high. The symptoms of slowly progressive pressure make the attending physician suspect an intracranial tumor. Localizing signs are often absent. If the meninges are involved there may be symptoms of meningitis. There are often rather characteristic psychic changes such as general confusion, disorientation, hallucinations, excitement, failing memory, *etc.* Cases have been said to simulate hysteria, epilepsy, and general paresis. Epileptic seizures, either generalized or Jacksonian in type, are common. Transient tonic spasms and automatic movements have been described. Dizziness and vomiting are common symptoms.[3]

The course of the disease is more or less intermittent, and usually of longer duration than that of brain tumor. Sudden death, however, when the lesion is within the ventricles, is not uncommon, as shown by the first of the two cases reported.

If the parasite is known to exist in the intestine of the patient, the diagnosis may be facilitated for it is highly probable that the patient has infected himself with the ova or segments. Usually an eosinophilia accompanies *Tænia solium* infestation, but it is not often found in the intermediary or cysticercus stage. Ophthalmoscopic examination, besides showing a papillœdema, may reveal the parasite within the eye. Its frequency here is even greater than that in the brain. Sullivan[7] describes a case in which a diagnosis was made in a patient having Jacksonian convulsions and a transient aphasia, upon finding hooklets of the parasite in the discharge from the ear.

Lumbar puncture and spinal-fluid examination may aid in the diagnosis. Discovery of the parasite, eosinophilia, increased brain pressure, a positive globulin reaction and a paretic type of gold sol curve are factors reported by Kulkov[8] upon which to base a diagnosis of cysticercus of the central nervous system. If, however, as often occurs, a brain tumor is suspected, lumbar puncture should be done with great care.

Röntgenograms may also be of aid by demonstrating calcified cysts as well as evidencing increased intracranial pressure from spreading of the sutures.

But few cases come to operation and most of these because brain tumor is suspected. Mintz[9] states that only twenty-seven cases had been operated upon up to 1927. In only one of these was there cerebellar involvement.

Complete recovery occurred in four cases, partial recovery in two. Mintz himself reported three cases, in two of which a diagnosis of cysticercus of the fourth ventricle was made before operation. Kimpton[10] reported an excision of a spinal cord tumor which proved to be cysticercus.

Progress in sanitation is gradually exterminating the parasite in the United States. Price[11] states that it is considered a "find" to discover it in the swine of Texas, and that it is usually found in counties having a large Negro or Mexican population. In the Philippine Islands[12] the number of infected pigs is astounding, for in 1921, one infected pig was found in every ninety-one which were examined. Rather paradoxical is the incidence of infection in man, however, for in Manila, in twelve thousand autopsies, only two cases were found. In Germany, although the incidence in swine is much lower, that in man is considerably greater,[13] a situation which holds for many other European countries as well. Quite a few cases have been reported in British soldiers who had seen service in India, and in individuals who had recently been in foreign countries.[14]

The two types of cysticercus infections of the brain are reported. In the first case, that of a solitary cyst obstructing the aqueduct of Sylvius, the location of the tumor could have been made by ventriculography. The cyst might have been removed by operation, but sudden death, so characteristic of tumors of the third ventricle, prevented even the making of a diagnosis. In the second case, that of generalized cysticercosis of the brain, the symptoms were those of a brain tumor localized to one region of the cerebrum. It is believed that operation, by ameliorating the acute symptoms, provided at least a good temporary result, and made recovery possible. The large decompression relieved the most acute pressure stage, and since progressive improvement has thus far followed the operation it is quite likely that it will continue. The probability of further improvement is enhanced also by the fact that the patient, now living in the United States and not harboring the adult parasite in the intestine, will not be subject to further infestation.

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CHONDROMA OF THE INTERVERTEBRAL DISKS

By Bernard J. Alpers, M.D., Francis C. Grant, M.D. and J C. Yaskin, M.D.

of Philadelphia, Pa.

From the surgical wards of the Graduate Hospital, and the Neurosurgical Laboratory of the University Hospital of Philadelphia

In the past five years there has come into prominence a clinical and pathological entity which has hitherto remained more or less unrecognized. This has been described variously as chondroma or enchondroma of the intervertebral disks, fibrocartilaginous extensions of the disk, and cartilage nodes. All probably refer to the same process, but as yet there is no general agreement concerning the true nature of these conditions. The entity in question consists of small cartilaginous extensions into the spinal canal, causing compression of the spinal cord. It is readily amenable to surgical treatment. We have recently had the opportunity of studying such a case, and because the subject is young and the occurrence of such tumors important to recognize, we wish to record the case in point.

Intervertebral Disk Extensions: What They Are.—Extensions of the intervertebral disk cartilages are of two types: (1) Extensions into the vertebral bodies, and (2) extensions into the spinal canal. The extensions into the bodies of the vertebræ need not concern us. They have been well described by Schmorl,[1] and produce no neurological symptoms of which we are aware.

The extension of the intervertebral disks into the spinal canal, however, are of great importance. They are accompanied by evidences of compression of the spinal cord, and their removal is attended by very encouraging results. Leaving aside for the moment the question of the etiology of these disk extensions, something may be said of their gross structure. They are small, cartilaginous extensions of the intervertebral cartilages which are usually to one side or another of the mid-line, most often on the left, are firmly anchored to the disk as a rule, and appear on the ventral aspect of the spinal canal. In a few instances they have been very loosely attached and could be picked out easily with forceps (Dandy[2]). These projections are firm, discrete, sometimes hard, and are usually covered with a sheet of dura under which they form a more or less prominent intraspinal projection. Their situation varies. Many have been reported in the lumbar region, but many also are found in the cervical portion of the spinal canal (Stookey,[3] Elsberg[4]). The clinical symptoms to which they give rise vary, of course, with the level of the cord compression, and with the area of cord which is compressed.

Attention was first called to these tumors by Stookey in 1928. Schmorl had reported a few years previously the extension of small cartilage nodes

into the vertebral bodies, but the recognition of their projection into the spinal canal must be attributed to Stookey. Adson[5] (1925) mentioned a few cases of this sort in a general study of spinal-cord tumors. As Bucy[6] has pointed out, the tumors in question are probably much less rare than reports indicate.

FIG. 1.—This view of the patient taken some time after operation shows the well-healed operative scar.

REPORT OF CASE.—*Severe trauma to back followed by pain in back and later in left leg, the latter persistent. Weakness of left leg. Absence of Achilles Reflex on left. Vague sensory findings to T–8 on left. Campiodol injection and arrest of iodized oil at L–3. Operation, with exposure of a small extradural tumor compressing roots of cauda equina on left. Histologically, a chondroma. Complete recovery.*

History.—E. F., a female aged forty-nine years, entered the Graduate Hospital of the University of Pennsylvania in April, 1931, on the service of Dr. William Bates. Three years previously she had slipped and fallen, striking violently on her buttocks. Sev-

eral hours later she developed pain in the small of her back, followed by pain in the left leg, which began to appear about one year after the fall. The pain in the leg, at first intermittent, later became almost constant. It was paroxysmal, beginning in the region of the left hip and radiating down the back of the thigh into the left foot. Often the pain was so severe that she found it necessary to assume the knee-chest position in order to obtain relief. Shortly after the development of her pain she began to notice weakness in the left leg, and at the time of the entrance into the hospital she was unable to walk without a limp. The right leg was singularly free from pain throughout the course of her illness. Within recent weeks she began to notice a numbness of her left leg.

A neurological examination revealed the weakness of the left leg to involve the muscles of the thigh, leg and foot. Movement of the left leg caused pain. On the left side,

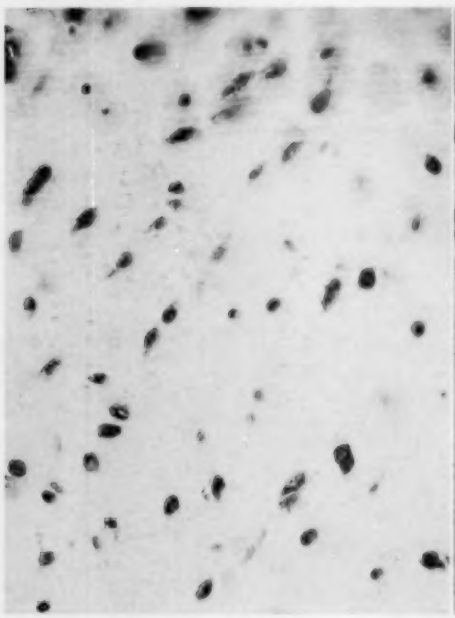

FIG. 2.

FIG. 3.

FIG. 2.—The cartilage cells seen in this photograph are from the tumor. Here and there are abnormal cellular forms which are not seen in normal cartilage. Hæmatoxylin-eosin stain.

FIG. 3.—On the edge of this tumor are several areas of this sort, composed of fibroblasts which can be traced in their development to cartilage cells. Transition forms from fibroblasts to cartilage cells can be seen in the lower portion of this photograph. Hematoxylin-eosin stain.

extending from the sole of the foot to the level of T-8, there was decreased sensation to touch, pin-prick, heat and cold. The left Achilles reflex was absent, the right was active, and both patellar and arm reflexes were active and equal. The abdominal reflexes were absent bilaterally. There was a positive Lasègue's sign on the left side. Repeated examinations confirmed the sensory findings noted above. While slight, they were nevertheless distinct. It was felt that the patient had a cauda equina lesion which was probably extradural and chiefly on the left side, but that there was also another lesion, probably at T-8.

A lumbar puncture was performed and no subarachnoid block demonstrated. The routine tests were negative. Because of the indefiniteness of the clinical signs and the long duration of the illness—three years—with relatively few clinical manifestations, a campiodol injection was done. X-ray after this injection showed that the iodized oil had stopped opposite the body of the third lumbar vertebra. In spite of all efforts to dis-

place it, the oil remained steadfastly in this situation. Another lumbar puncture was done therefore between the fourth and fifth lumbar vertebræ, and with the needle in this position it was found that a block could be demonstrated. Furthermore, the spinal fluid removed from this locus had a xanthochromic appearance. X-ray examination of the dorsal and lumbar spine revealed an old hypertrophic osteoarthritis, but nothing else of significance.

Operation.—May 18, 1931, Grant laminectomy, removing the third, fourth and fifth lumbar and first and second sacral spines and laminæ. On coming down on the lower end of the cord, the dura was dark and seemed to be markedly swollen. The dark and swollen region was found to contain nothing but cerebro-spinal fluid, which was xanthochromic. Just above this area, impinging on the cord from in front, hemping up the dura and compressing the nerve-roots, was a whitish mass. This was extradural and

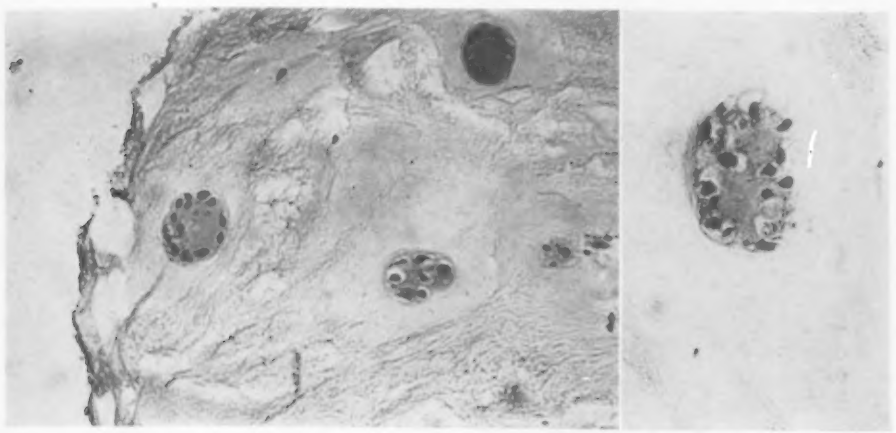

FIG. 4.—Here and there in the tumor tissue, usually at its periphery, are found these large, multinucleated forms which seem to be characteristic of this type of tumor. Hematoxylin-eosin stain.

anterior to the cord. It seemed to involve the nerve-roots emerging from the third lumbar vertebra. The cauda equina roots were carefully retracted and an incision made into the protruding mass which seemed to arise from a point beneath the transverse processes of the third and fourth lumbar vertebræ. The contents were removed with a curette. They seemed to be cartilaginous in nature. The mass was firmly anchored and arose from the intervertebral disk. The patient developed a post-operative pneumonia from which she recovered. Her leg pain cleared up entirely, and all her neurological symptoms disappeared. The Achilles reflex remained absent on the left side for some time after operation. The sensory findings cleared up after removal of the tumor.

Etiology.—Intervertebral disk extensions are found more frequently in males than females. In a study of 737 cases with cartilage nodes Schmorl found that the majority were in males. His figures include cartilage nodes which had extended into the vertebral bodies. Most of Elsberg's cases, too, were in males. He believes they are rare before thirty, and are commonest about fifty. They do occur, however, in individuals below thirty. In Elsberg's cases the average age was fifty, the age ranging from thirty-eight to sixty-eight. Andræ[7] has studied the frequency of their extension into the spinal canal. He found in a study of 368 necropsies that there were extensions of the intervertebral cartilages in 15.2 per cent. Schmorl believes

that they are even more frequent than this. In Elsberg's second hundred cord tumors there were fourteen ventral chondromas.

Trauma seems to play an important rôle in their production. Many investigators have found that trauma could be demonstrated in their cases. The importance of trauma as an etiological factor has been denied, however, both by Stookey and Elsberg. The former states that "no history of trauma or of any special occupational activity requiring continuous movements or strain on the cervical vertebræ could be established." In the following table some idea of the incidence of trauma can be gleaned from the reported cases. Twenty-nine reported cases are included in this table, and of these trauma has been reported in only five instances.

TABLE I

Incidence of Trauma

Author	Nature of Trauma
Stookey	None
Elsberg	None
Schmorl	None
Alajouanine and Petit-Dutaillis	None
Dandy	(1) Severe jolt in riding horseback (2) Strain while pushing automobile
Bucy	Lifting heavy piece of iron
Alpers, Grant and Yaskin	Severe fall on coccyx
Crouzon, Petit-Dutaillis and Christophe	Fall on back from height of four metres

There are two reasons why trauma has not been reported more frequently in the recorded cases: First of all, no effort has been made to determine specifically whether trauma occurred, and then again, its appearance in the history may have been of so insignificant a nature as to be disregarded. Unless the rôle of trauma in the causation of the disorders under discussion is realized, this factor may readily be overlooked. Often it is necessary to obtain a history of trauma in retrospect, and experience seems to show that often such a history is obtainable. In our case the entire symptomatology was directly traceable to the blow, a sudden, severe fall on the coccyx. Such a direct and logical connection does not seem to be common. In all the cases in which trauma has been a factor in the disease, it has been marked, and has usually been sudden and severe, the result of an unusual strain on the muscles of the back.

Prolonged minor traumata are also held responsible by some individuals for the condition. Their relation to the disk growths is less certain. Severe trauma plays an important part in the production of the condition under discussion: it may not be responsible in all instances, but it is a striking factor in some, and in our opinion is more frequent than can be demonstrated from a perusal of the reported cases.

Moreover, these disk extensions are found most commonly in those portions of the spinal canal which are subject to greatest trauma and to most

frequent use. They are found chiefly in the cervical and lumbar regions of the spine. The former is the most mobile portion and probably the least well protected portion of the spinal column, and both through constant motility and direct trauma it is subject to the formation of these disk tumors. The lumbar spine is particularly subject to these growths because it is frequently injured in falls, and is probably subjected to more constant strain than any other portion of the vertebral column.

Location.—The location of these intervertebral disk extensions is not a matter of uniformity. It has been stated by some that these tumors occur most frequently in the lumbar portion of the vertebral column (Schmorl, Andræ, Sashin[8]). This would be true were it not for the extensive experience of Stookey and Elsberg with these growths. In every one of the seven cases of Stookey, and in nine of the fifteen cases of Elsberg, the lesions were in the cervical portion of the vertebral column. Only four of Elsberg's cases involved the lumbar region of the spinal column.

Of the thirty-five cases which we have found reported in the literature, sixteen, or 46 per cent., involved the cervical area of the vertebral column; thirteen, or 37 per cent., were in the lumbar area; and six, or 17 per cent., were found in the thoracic portion of the vertebral column. These growths are therefore somewhat more frequent in the cervical than in the lumbar region on the basis of these few reported cases, but the accumulation of more cases could easily swing the preponderance the other way, or at least equalize it.

TABLE II

Location of Tumors

Author	Cervical	Thoracic	Lumbar
Stookey	7		
Schmorl[9]		3	
Dandy			2
Bucy			1
Alajouanine and Petit-Dutaillis			2
Elsberg	9	2	4
Crouzon, Petit-Dutaillis and Christophe			1
Alpers, Grant and Yaskin			1
Von Pechy[10]		1	
Robineau[11]			2

Thirty-five Cases.—Cervical, 16, or 46 per cent., thoracic, 6, or 17 per cent., lumbar, 13, or 37 per cent.

Gross Pathology.—The intervertebral disk projections into the spinal cord vary in size from a pea to a bean. They are usually flat, with a smooth and sometimes lobulated surface, and with a longish, or spindle-shaped form. They are firm, often bony hard, but are frequently soft. They are found practically always in the mid-line or just to one side of it. The posterior longitudinal ligament of the vertebral column covers them, and so does the dura as well. They are therefore extradural bodies. They appear as a gray

to a yellowish-gray structure through the membranes mentioned (Andræ). Usually they are firmly anchored to the intervertebral disk, but sometimes they are found as loose pieces of cartilage (Dandy). Andræ says that in about 50 per cent. of cases these growths are multiple, and it is a matter of great interest that in the cases in which he found these excrescences he states they were never large enough to cause a spinal-cord compression. In some cases, ossification has been observed (Stookey, Robineau,[11] Schmorl).

It is presumed (Schmorl, Andræ, Sashin) that the intervertebral disk extensions represent a prolapse of the nucleus pulposus, secondary to a tear in the annulus fibrosus. "As a result of a severe trauma or degenerative changes of the annulus fibrosus, an avenue may be established for the extension of the expansile fibres (of the nucleus pulposus) against the posterior longitudinal ligament." (Sashin.) It seems hardly likely that this is the case, because in sixteen cases which Andræ found there were no direct connections between the disk extension and the nucleus pulposus. There was always intact annulus fibrosus between them. In some instances it has been possible to demonstrate a tear in the annulus fibrosus at necropsy.

The tumors, however, are composed usually of fibrocartilage, and in this respect resemble much more closely the annulus fibrosus rather than the nucleus pulposus. It would seem more likely, therefore, that they develop as outgrowths of the fibrocartilaginous annulus fibrosus rather than form the nucleus pulposus, probably in response to trauma which may or may not produce a tear in the intervertebral disk. There then results a hyperplasia of the cartilage which sometimes reaches a size sufficient to produce clinical signs and symptoms. Only those cases which are large enough to cause symptoms come to our attention, but it should not be forgotten that many cases of this sort exist without evoking any symptoms during life (Andræ). Furthermore, a routine examination of the posterior portions of the vertebral bodies at operation would probably reveal quite a high incidence of these symptomless hyperplasias.

Histological Character of the Growths.—The question arises whether these disk extensions are true tumor growths or whether they are to be looked upon as ecchondroses. The distinction, after all, is one of degree rather than of kind. It is as difficult to determine where an ecchondrosis ends and a chondroma begins as it is to reach the same decision concerning hyperostosis and osteoma. Our case exhibited all the evidences of a cartilaginous neoplasm. The tumor-cells varied much in size and shape, lay in a fibrocartilaginous matrix, and on the borders of the tissue were immature cells of a fibroblastic nature from which transitions to the tumor-cells, many of which were multinucleated, could be traced. Bucy's case showed a similar structure, and he considered it a true cartilaginous tumor. Elsberg was not certain after a study of his cases that they constituted true tumors, and was inclined to believe that they represented ecchondroses or hyperplasias in the strict histological sense.

The size of the growth cannot be a criterion of its neoplastic nature.

Many true tumors are very small, yet they exhibit all the evidences of a neoplasm. The most important evidence of neoplastic formation which we have in our tumor is the presence of fibroblasts on the edge of the growth, from which many transitions to cartilage cells could be traced. Similar cells were present in Bucy's case. These cells were in process of active growth, and would undoubtedly have swelled the size of the tumor if they had been permitted to function longer. Further, evidence of the tumor nature of the growth is given by the multinucleated cells which were quite numerous in our tumor. By some, these cells have been considered to be physalide cells of Virchow, related to the primitive notochord (Alajouanine and Petit-Dutaillis[12]). They are more probably tumor-cells of a multinuclear nature.

True cartilage cells are found everywhere in the fibrocartilage matrix. Sometimes these cells are grouped in twos or threes. They are quite widely scattered, very much as in normal cartilage. The matrix exhibits no peculiarities which stamp it as different from normal fibrocartilage. We could demonstrate no elastic fibres in our tumor.

These tumors are encapsulated—that is, their surface is covered by a thin capsule, except at their base, where they are anchored to the intervertebral disk. It seems probable, therefore, that they may not be removed in their entirety, and that recurrences may appear if any tumor tissue remains behind at the anchorage base.

Clinical Features.—The clinical picture of these tumors varies, of course, with their location. Elsberg, who has studied the largest series of these cases, says that the clinical picture is that of compression of the cord from its anterior aspect with definite motor disturbances and cutaneous sensory loss with relatively little involvement of tactile sensibility, the preservation in most instances of vibratory and joint senses, and the relatively infrequent involvement of the sphincters. Subarachnoid block is more infrequent in these cases than in other tumors of the membranes or cord substance. X-ray of the spine rarely shows evidence of the growth, though Sashin has stated recently that it is possible to detect these tumors by X-ray studies.

In Stookey's study of the cervical ventral chondromas, he found that they were present in three locations: (1) Ventral and in the mid-line, exerting bilateral ventral pressure; (2) ventral and unilateral, producing unilateral ventral pressure; and (3) ventral and lateral, exerting pressure only on the roots, and giving rise only to root signs. "The most characteristic picture is that of marked unilateral spasticity, with atrophy and weakness of the muscles of one or two cervical segments at the level of the tumor and on the side of the spasticity, and changes in pain and temperature sense on the opposite side. Muscle, joint, vibratory, and discriminative sensations are unaltered."

The lumbar ventral chondromas often give rise to cauda equina syndromes. Here the clinical picture is one of back pain, which is followed sooner or later by pain in the sciatic-nerve distribution, and is attended by muscle wasting, loss of muscle power in the muscles affected, by reflex disturbances,

usually a diminution or loss, by diminution or loss of sensation in the segments affected, and occasionally by sphincteric disturbances. In our case, we were able to demonstrate a relaxation of the anal sphincter. Subarachnoid block may be present either partial or complete (Bucy, Alpers and Grant). Lipiodol injection is of help in many of these cases. In our case the lipiodol stopped at the level of the mass, but in a case of Alajouanine and Petit-Dutaillis, it failed to reveal the mass.

One word of caution is necessary concerning the cauda equina syndromes caused by these tumors. It is more or less a neurological law that cases of bilateral sciatic pain should be looked upon as being caused by a tumor until otherwise proved to the contrary. Cases of unilateral sciatic disease are not usually considered to be due to tumor. Nevertheless, several cases of this sort are reported in these series of tumors (Alpers and Grant, Alajouanine and Petit-Dutaillis, Crouzon, Petit-Dutaillis and Christophe[13]). It seems advisable to keep in mind the possibility of such a tumor when given a history of trauma, followed by backache and unilateral sciatic pain, accompanied by the objective disturbances detailed above. It is a rare cause, to be sure, but a cause which is readily removed, and with good results as a rule.

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PRIMARY HÆMANGIOMA OF THE SPINE

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The diagnosis of primary hæmangioma of the spine is a comparatively recent clinical entity. The considerable number of these found at post-mortem examination warrants the assertion that this pathology must often be incorrectly diagnosed. We wish here to present one case of hæmangioma involving the spinal column, which has been proven by biopsy, and one additional, which we believe so typical that the diagnosis is assured.

The first published röntgenogram of hæmangioma of the osseous system was that of Hitzrot,[1] in 1917, but it remained for Perman,[2] in 1926, to give us our first proven case of primary hæmangioma of the spinal column. When we realize from the work of Topfer,[3] in 1928, Putschar,[4] in 1929, and Schmorl[5] that this pathology is found in 11.93 per cent., 6 per cent. and 10 per cent., respectively, of the vertebral columns examined at autopsy, it is easy to see that the wide divergence between clinical and laboratory findings must constitute considerable error in diagnosis. Makrycostas[6] found eleven cases post-mortem, none of which had given symptoms ante-mortem, and this is the rule with the great majority.

In a recent excellent paper, Bucy and Capp[7] have given us the criteria for diagnosis of this condition, after having reviewed all the published cases of involvement of the spinal column together with similar findings in the remainder of the osseous system. To the previously reported eleven cases showing symptoms they added another, and admirably summarize the röntgenological and pathological findings.

In the clinical cases previously reported, the diagnosis was concurrent with a compression myelitis, and diagnosis was always made after surgical work for the relief of the latter. It is the belief of Bucy and Capp that this diagnosis should be made from the röntgenograms, and we believe that the cases herein reported bear out this conclusion. There is a characteristic röntgen finding in primary hæmangioma of the spinal column.

The apparent incongruity between the pathological and clinical in this lesion is, in good part, accounted for by the fact that the only symptomatology so far reported has been that which results from the extension of the process through the cortex and into the spinal canal, producing compression symptoms. In all of Topfer's cases there were no clinical findings to suggest the presence of these lesions. This, then, leads us to the conclusion that the principal value of the diagnosis of these cases must lie in its exclusion in differential diagnosis of lesions of the vertebral column. At the same time, it is worthy to note from the cases herein reported, less severe symptoms may suggest this diagnosis.

These tumors vary greatly in size from that of a pea to complete involvement of the entire body and pedicle. There is a predominance in the female of two to one. The most common site is in the lower dorsal and upper lumbar vertebræ, and the early twenties are the most common ages of occurrence with clinical symptoms.

Differential diagnosis presents the following to be considered.

(A) *Tuberculosis.*—The absence of abscess formation with the attendant febrile and general symptomatology serves to differentiate the moist type. The dry type (Caries sicca) may present some difficulty, but if it is remembered that hæmangioma practically never results in compression of the body, as well as the characteristic appearance of the röntgenograms, differentiation should not be difficult.

(B) *Osteomyelitis.*—The chronic or subacute types will present difficulty from the röntgenographical side, but clinical symptomatology should be more clear-cut. (Abscess formation will be the ultimate differentiation point.)

(C) *Malignant Tumors.*—(1) Metastatic carcinoma will be excluded by the discovery of the primary focus, the severity of clinical symptoms, the extensiveness of the disease, and the absence of typical destruction, together with the progress of the condition. From the röntgenological standpoint, as well as the clinical, the röntgenographs with fewer but denser lamellæ in hæmangioma clearly differentiate. (2) Sarcoma, while primarily a rare finding in the spine, could give considerable difficulty and must rest on progress or biopsy for exclusion.

(D) *Other Inflammatory Processes.*—Among these actinomycoses, and echinococcus should be considered, but the clinical picture with a more extensive destruction makes their confusion unlikely.

(E) *Kummel's Disease* (*Post-traumatic Kyphosis*) presents a wedging of the vertebral body with a history which is suggestive.

All of these can be readily ruled out if the appearance of the röntgenogram in hæmangioma is remembered. The presence of a porous appearance with striæ, the lime content of the lamellæ undisturbed or increased, and the absence of compression, is diagnostic.

Case I.—Mrs. J. D., twenty-two years of age; Portuguese-American; housewife. Referred by Dr. A. Reis, of Oakland.

Complaint.—Recurrent periods of loss of consciousness—six months. Pain in low back—six months. About six months ago she began having periods of loss of consciousness, which occurred at irregular intervals with gradually increasing frequency. These have come to be a great source of fear to her and are the reason she presents herself for examination. These have been traced to a dislike of her husband, and have not recurred since they have separated. There has also been occasional pain in her low back, which bears no relation to her above complaint or to any physical effort. She can move in all directions without limitation. This pain, she suggests, may have been due to striking her back against a table previously.

Married two years ago. Menstrual history normal. No pregnancies. Has always been well. Does not recall any childhood diseases. No history of injury other than above stated. Mother and father alive and well. Nothing suggestive of family weakness or inheritable deficiency.

Laboratory.—Blood Wassermann, negative; urine, normal; blood count, slightly elevated white blood count with normal differential. *X-ray examination.*—Antero-posterior and lateral of skull in stereo—normal. Anteroposterior and lateral of dorsal spine—negative. Anteroposterior and lateral lumbar spine—disclosed a destructive process with retention of normal lamellæ, involving the body, transverse process and pedicle of the third lumbar. Vertebral diameter normal—no compression. The right transverse process is enlarged over the left. (Fig. 1.)

She is a well-nourished and developed young woman of stated age. Normal throughout except for tenderness on pressure over the third lumbar and muscle spasm incited by percussion over it. Movements of spine free. No palpable deformity or mass noted, except a suggestion of a fullness on the right flank. Reflexes—greatly hyperactive throughout. Sensation—intact throughout. Pelvic and rectal examination—negative.

The diagnosis of Doctor Van Nuys was a hæmangioma of the vertebræ. It was not clear at this time if there was any relation between this and the cerebral symptoms manifest. The differential diagnosis was between a chronic osteomyelitis and a hæmangioma. A biopsy by puncture was first tried. The needle ran into hard bone and no material suggestive of an osteomyelitis was found in smears made. September 11, 1930, surgical biopsy was done, and through a right lateral incision by muscle splitting the

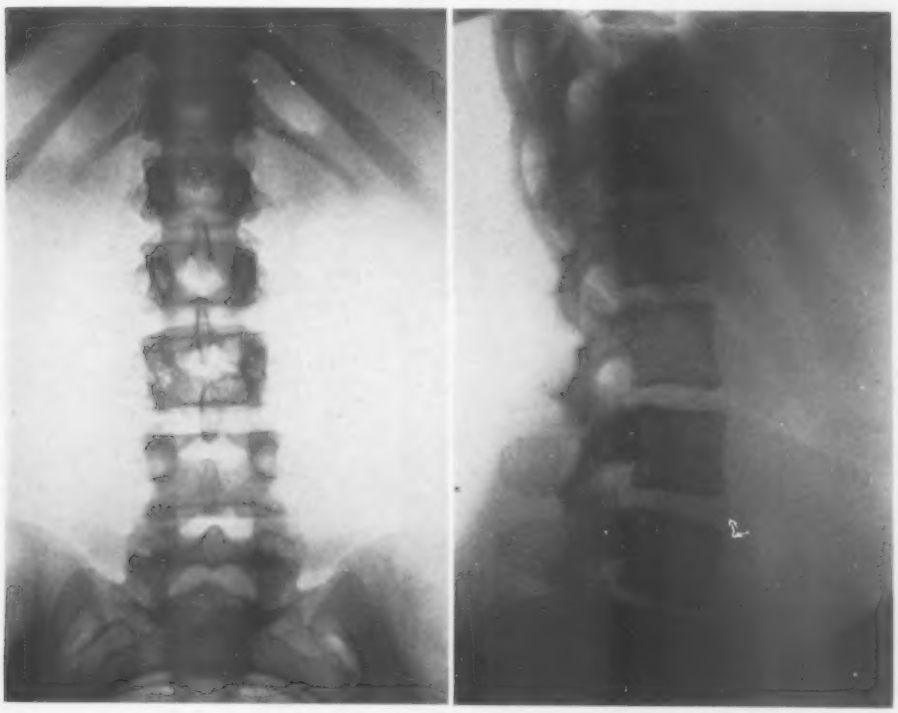

FIG. 1.—Anteroposterior spine. Lateral spine.

FIG. 1.—Röntgenogram of Case I. Primary hæmangioma of the spine, showing a destructive process with retention of normal lamellæ involving the body, transverse process and pedicle of the third lumbar vertebræ. Note the vertebral diameter is normal—there being no compression.

transverse process was exposed. Considerable bleeding was encountered. The bone in the process was hard and resisted a curette very positively. Two pieces were finally secured for sectioning. Extensive hæmorrhage necessitated packing, which finally controlled it.

For some weeks following she complained of pain along the second and third right root distribution, probably the result of trauma to them at surgery. This gradually cleared.

The sections were made by Dr. W. Reich, who reported: (Fig. 2.)

Gross appearance.—Two small scraps of bony and soft tissue submitted. *Sections* show bony tissue which presents no apparent abnormalities. The soft tissue is composed largely of tissue presenting the histology of an angioma. Numerous small capillaries

lined by low cuboidal cells permeate this tissue. Many of the capillaries contain red blood-cells; in places the endothelial lining appears hyperplastic. The capillaries lie imbedded in a delicate fibroreticular stroma which exhibits a very mild degree of small round-cell infiltration. Smooth muscle, fat and fibrous tissue compose the remainder of the sections. *Histopathological diagnosis*—angioma.

She was then referred to Dr. S. A. Jelte, who administered deep röntgen-ray therapy, the dosage of which was over the affected vertebræ.

Recent X-rays after this treatment seem to show a recrudescence of the lesion with increasing density in the bony structure of the vertebræ.

On comparing this case with that of Perman's, there is a marked similarity in the X-ray pictures—there is absence of compression with a motley thinning out and a porous appearance. The lamellæ have a normal lime content.

To summarize we have here a young woman with an indefinite lesion of her third

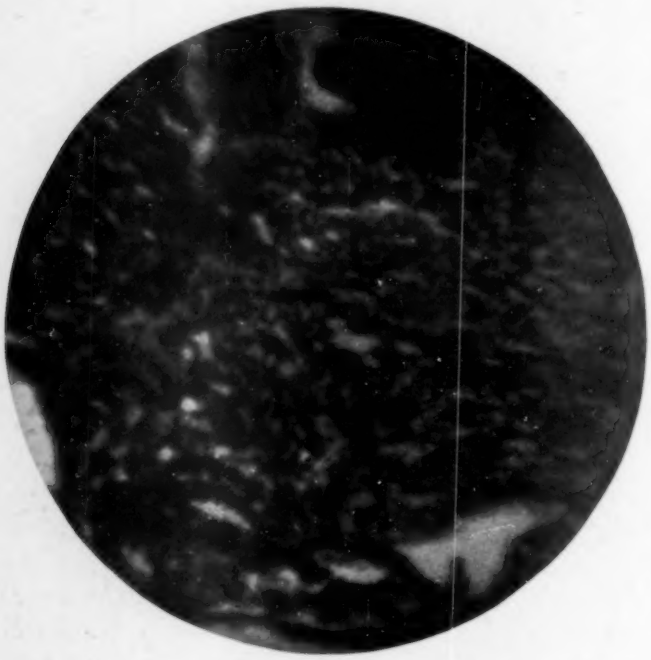

FIG. 2.—Sections of angiomatous tissue removed at biopsy from Case I. Note numerous small capillaries imbedded in a fibroreticular stroma.

lumbar vertebræ, involving the pedicle, arch and transverse processes, as well as the body, without compression, in which a diagnosis of hæmangioma was made pre-operatively and confirmed by biopsy.

CASE II.—S. M., forty-two years of age; white; school teacher; married. First observed at Berkeley Health Center and later at Fairmont Hospital.

Complaint.—Pain in the back, eleventh and twelfth ribs, with epigastric distress and general abdominal soreness. She has always been in poor health since childhood. At seven years of age she had meningitis following a fall on the ice. Her present pain is present on awakening and worse in the mid-forenoon and afternoon. It is relieved by codeine grains 1, which she has been taking three to eight times daily. The backache is worse on fatigue. During the past two years pain has become generalized over the body. She has a very poor appetite, repeated attacks of nausea with pain in the right upper quadrant. During the past twelve years she has lost thirty pounds in weight. Gall-stones have been present in previous X-rays. She has undergone many

methods of treatment, but without relief of her symptoms. There is occasional burning with nocturia one to three times. She had typhoid fever at the age of thirty-five years. Fistula in rectum at the age of fifteen years. Tonsillitis and influenza many times. Married; one child alive and well. Menstrual history normal. She is a fairly well developed and nourished white woman, appearing forty years of age, intelligent and coöperative.

Her abdomen is soft and thinly covered. Suggestion of a mass below the right costal margin. Tenderness on pressure in mid-epigastrium and gall-bladder area. There is a marked area of hyperæsthesia across the umbilical zone following very definitely the course of the eleventh and twelfth dorsal nerves. There is pain on pressure over the twelfth rib, which she states involves the whole body.

There is tenderness complained of on pressure over the spinous processes of the sixth dorsal to the fourth lumbar vertebræ. There is a limitation of motion in move-

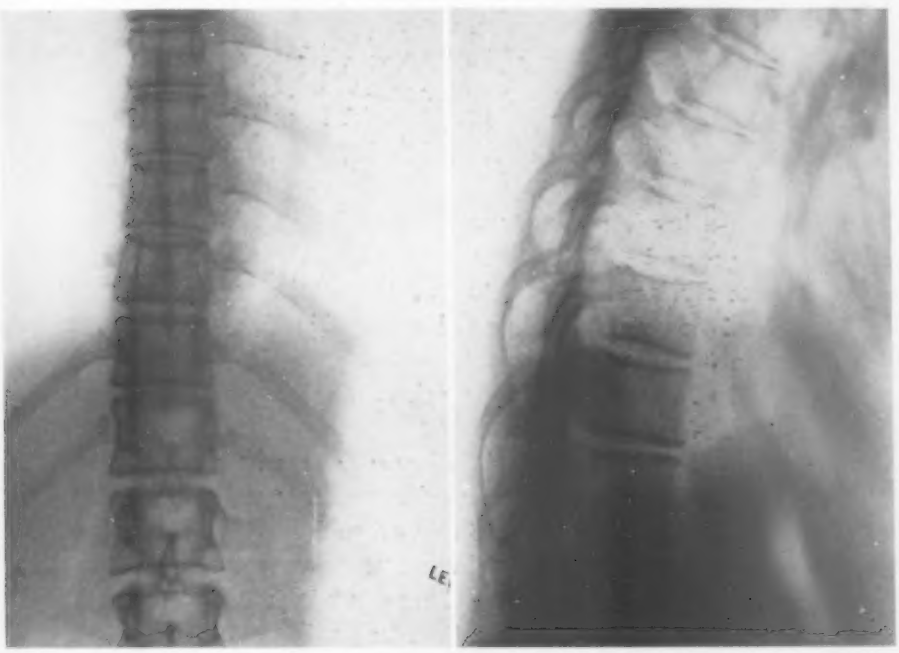

Fig. 3.—Anteroposterior spine. Lateral spine.

Fig. 3.—Röntgenograms of Case II. Hæmangioma of the spine. Note the porous appearance in the tenth dorsal vertebra with diminution in the number of lamellæ but normal lime content.

ments of the dorsal spine with muscle spasm and complaint of pain centering about the eleventh dorsal vertebra. *Blood Wassermann.*—negative. *Blood.*—Hæmoglobin, 90 per cent.; red blood-cells, 4,290,000; white blood-cells, 6,650; polymorphonuclears, 60 per cent.; lymphocytes, 36 per cent.; mononuclears, 3 per cent.; basophiles, 1 per cent.

In the Röntgen-ray pictures anteroposterior and lateral films of dorsal spine show an alteration in the tenth dorsal as follows: Porous appearance of the body with diminution in the number of lamellæ but normal lime content. Lateral extension into rib. No compression. (Fig. 3.) This same picture is seen in X-rays made in 1928 by Dr. S. A. Jelte. There is no progress in the disease. At this time he had given her deep röntgen therapy without any relief of symptoms.

Her entering diagnosis was metastatic carcinoma of the spine, but in view of her not being the picture of this condition and in the absence of finding the primary focus, her gall-bladder was treated medically. Diathermy was given over the area of the spine complained of. She improved under this treatment. Later her gall-bladder and appendix

were removed surgically and showed chronic inflammation. She recovered from this and has been quite well since. Last report, April, 1931, she is working steadily and has no complaints of her back condition.

Discussion.—The etiology of this condition is obscure; however, the known vascularity of the vertebral body with its large veins in the spongiosa anteriorly permits an adequate site for their origin. Putschar has divided them into two groups, the first and most rare composed of those which occupy the central point in the anatomical condition with destruction of the bone involving the arch and pedicle, and giving marked clinical symptoms; the second comprising those which have occasioned no symptoms during life and occupy a minor position, *i.e.*, are not blastoma but venous enlargements in preëxisting cystic or degenerative areas of the body. He admits that externally no changes may be recognized in the vertebræ to contrast these two groups.

We are inclined to agree with Putschar, for in no other way can we reasonably account for the rarity of clinical findings as compared with the post-mortem findings.

The first case herein reported would then belong to the first group—being present in a young individual, producing destructive changes with definite clinical symptoms, also responding to Röntgen-ray therapy.

The second case, occurring in an older individual, produces changes suggestive of the first group. However, its stationary appearance over three years with lack of response to deep-ray therapy makes its classification somewhat doubtful.

Treatment has been clearly outlined by previous writers and resolves itself into laminectomy if pressure symptoms are present followed by radiation therapy. In our cases one seemed to respond to deep Röntgen-ray treatment, while the other was apparently unaffected, though there has been an arrest of symptoms. It might reasonably be assumed that the first group in Putschar's classification would respond to radiation, while the second would not.

From the post-mortem examinations it is certain that approximately 10 per cent. of spines show this pathology. The number of these cases, as Makrycostas brings out, can be increased as desired by continued examination of vertebral columns.

SUMMARY

(1) Primary hæmangioma of the vertebræ is a comparatively common condition but rarely gives rise to symptoms. Ten per cent. of post-mortems demonstrate it.

(2) Diagnosis should be made from the röntgenograph which is typical.

(3) There are apparently two types, one being a true neoplasm and producing symptoms, the other a telangiectasis into a previously pathological vertebræ.

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POST-TRAUMATIC PAINFUL OSTEOPOROSIS

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The fact that the osseous frame-work of the body undergoes rapid and extensive physico-chemical changes under the influence of the circulatory disturbances that frequently follow traumatization of an extremity, emphasizes that the bones are not inert supporting structures with a fixed and unchangeable constitution, but that they are able to react in exactly the same way as the other tissues of the body.

After an extensive study of the post-traumatic vasomotor syndromes of the extremities, made over a period of many years, Professor Leriche has demonstrated the great importance of one special variety of the syndrome which is characterized by constant severe pain associated with stiffness of the neighboring joint or joints. This variety is relatively common, it causes marked disability and it greatly prolongs the convalescence of the patient. It is our purpose to give a complete study of this post-traumatic painful osteoporosis and to show some of the striking benefits that have been obtained in such cases by operations upon the sympathetic nervous system.

Historical review.—In 1900 Sudeck described acute reflex atrophy of bone and established it as a clinical entity. His first report concerned the type of acute atrophy that follows inflammatory processes of the articulations, but later he described a type which he called post-traumatic reflex atrophy of bone. He clearly differentiated between the type following fractures of bones, trauma to articulations, and simple torsion of the joint. He compared the reflex atrophy with the type described previously by Virchow, Charcot, Chambers, and others in relation to certain nervous diseases, especially tabes dorsalis and syringomyelia.

As early as 1877 Wolff described trophic changes in the extremities of adults and disturbances of growth and trophic changes in children following infectious arthritis or resection of a joint. A critical analysis of these cases by Cassirer in 1912 seems to show that the changes observed by Wolff were actually the end-results of bone atrophy.

In 1901 Kienböck added further to the clinical description of the disease entity and he gave an accurate description of the röntgenological changes that are characteristic of it. Both Sudeck and Kienböck showed that inactivity could not account for the severe degree of atrophy, that it appeared much earlier than the atrophy of disuse and that in many cases the atrophy of the bone came on while the extremity was still in use.

Exner (1902) made an accurate gross and microscopic study of the atrophic bones. Nonne (1902) described similar atrophy of bones associated with pathological lesions of the peripheral nerves. Imbert and Gagnière

(1903) and Destot (1904) also added to the clinical description and röntgenologic picture of this disease. Benkwitz (1906), Ziesche (1907), Bibergeil (1911) and Brandes (1913) reported many interesting clinical studies in Germany, while Bienfait (1907), Delherm (1911), Moreau-Gimelli (1912) and Halipré (1914) made the disease entity known in France. In 1919 Hitschmann and Wachtel described typical cases of osteoporosis following severe frost bites. Dubs (1921) reported extensive osteoporosis following burns, but he emphasized that the extent or severity of the osteoporosis bore no relation to the extent or degree of the burns. Osteoporosis was only initiated by the burns as it continued long after the burns had healed.

Legg (1908) made a study of the atrophy of bone that resulted from infectious arthritis which he produced experimentally. The experimental work of Grey and Carr (1915) and of Allison and Brooks (1921) concerning the atrophy of bone which follows injuries of the large nerves of the extremity, that which occurs after changes in the vascularization of the part, and that type which follows prolonged immobilization, has added much to our knowledge concerning the factors which are responsible for this disturbance.

Turner (1924) reported osteoporosis following Colles' fracture and he pointed out the possibility of sensory nerve involvement. He observed that osteoporosis was more marked on the ulnar side of the hand; consequently he felt that injury of the dorsal interosseus nerve or the dorsal cutaneous branch of the ulnar nerve might have played a part in bringing about the atrophy of the bones.

Theories concerning etiology.—In all the recent work there has been no evidence that the disease is of an inflammatory nature as Sudeck originally supposed it to be. Vialleton (1922) failed to find any evidence of cellular infiltration of an inflammatory nature in any of the specimens of porotic bone which he examined histologically.

At the present there are two main hypotheses concerning the etiology of post-traumatic osteoporosis. The first is that the disease is the direct result of the trauma and that the changes in the bone are brought about by reflex action upon the trophicity or the vascularity of the bone. The second theory is that osteoporosis comes on indirectly and that it is due to inactivity or loss of functional stimulation.

Sudeck showed that the atrophy of inactivity was able to reach a very pronounced degree in amputation stumps, but both Sudeck and Kienböck felt that true osteoporosis comes on much more rapidly than could be explained on the basis of inactivity alone.

In 1913 Brandes studied this problem experimentally. He resected the tendon Achilles in order to immobilize the foot and then studied the density of the calcaneus at regular intervals after complete fixation of the foot by a plaster-of-Paris bandage. He showed that the atrophy of inactivity came on very early—just opposite to the findings of Sudeck and Kienböck. Brandes' results were similar to those obtained by Pillet in 1906.

In 1915 Grey and Carr made similar experiments, and they also showed that the atrophy of inactivity came on early. They concluded, however, that the atrophy was due to an absence or deficiency of the necessary functional excitation to the nutrition.

Allison and Brooks (1921) obtained similar results. The röntgenological pictures of the atrophy of bone which they produced in animals by inactivity showed the same characteristics as the atrophy of bone in man. They demonstrated the characteristic changes in the trabeculæ of the epiphysis of the bones, and they pointed out that the degree of atrophy was in direct proportion to the length of time of immobilization. The histological structure of the bones of experimentally produced osteoporosis was identical with that found in the porotic bones from man.

Guarini (1918) explained such osteoporosis on the loss of functional activity with the resulting state of anæmia of the member and a deficit in the calcium salts that were being brought to the bone by the blood-stream. The reports of Delorme (1916) concerning the condition of the bones of seven soldiers in whom severe shrapnel wounds necessitated the ligation of the principal artery of one extremity fail to substantiate that theory, since no röntgenological evidence of atrophy of the bones was ever noted in any of these patients. Allison and Brooks were unable to produce atrophy of bone experimentally by ligation of the principal artery of the extremity. Attempts have also been made to produce atrophy of bone experimentally by local venous congestion, but these experiments have also been unsuccessful.

The remaining theory concerning the etiology is that attributed to the lack of functional excitation of the bone. Dauriac (1919) states that the absence of axial thrust is able to bring about a rarefaction about the ends of fractured bones. In extreme cases he states that this rarefaction goes on to the production of a pseudoarthrosis. In final analysis it is difficult to determine the exact nature of this "axial thrust" or "functional excitation."

It is quite probable that trauma of the peri-articular tissues has, in some cases at least, played a definite rôle in the production of the rarefaction which was attributed to the immobilization by the plaster case. It is true that simple immobilization does not always produce an extensive atrophy of the bones so, perhaps, there are still other factors which play a part in bringing about the rarefaction in such instances. Clinically it is well known that extensive osteoporosis frequently comes on in patients whose extremities had never been immobilized.

Osteoporosis is relatively rare after fractures of the diaphysis of bones and quite common after trauma, with or without fracture, of the peri-articular or juxta-articular regions. Marked vasomotor changes of an extremity have been produced experimentally by Albert (1924) and by us (1927) after various kinds of injury to the peri-articular tissues. The fact that osteoporosis is still more frequent after trauma to the poly-articular regions such as the ankle or the wrist, is suggestive evidence that stimulation of the nu-

merous articular and peri-articular nerves brings about the vasomotor changes that are ultimately responsible for the production of the osteoporosis.

The oscillometric studies made by Professor Leriche in 1917 show that, in man also, peri-articular trauma is followed by a marked vasomotor disturbance in the extremity. Slight trauma to the poly-articular regions usually produces a very marked vaso-dilatation, but it may, on the contrary, produce a vaso-constriction. Leriche and Fontaine (1929) have shown that the traumatization frequently causes a block in the local circulation at the site of the injury. This block of the circulation may be caused either by marked vaso-dilatation or by marked vaso-constriction. It is this difference in the local reaction to the trauma that determines the various clinical pictures of this disease. It is generally thought that osteoporosis appears only after violent trauma, fracture of a bone, or some severe contusion of a joint. However, recent extensive studies have convinced us that marked osteoporosis may follow a very slight trauma to the soft tissues around a joint. The peripheral vascular disturbances associated with spasm of the surrounding muscles which was originally described by Babinski and Froment (1917) as "physiopathic troubles" has recently been shown to give rise to osteoporosis in the great majority of the cases.

In the early stages of osteoporosis there is always a local hypervascularization as shown clinically by the increased local temperature and the increase of the oscillometric index. The phenomena of vaso-constriction are uniformly found in the late stages of the disease. Leriche and Policard have studied the problem in detail, and they have shown that hyperæmia is a necessary factor for the absorption of bone.

We are of the opinion that true osteoporosis is the direct result of the hyperæmia produced by vasomotor changes that result from reflexes which originate in the traumatized area.

Site and frequency.—Osteoporosis is most frequently found in the short bones of the hands and feet. Next in order of frequency is the epiphysis of metatarsals, metacarpals and phalanges, and then the epiphysis of long bones. The diaphysis of long bones is rarely involved. The flat bones of the skull may also be the seat of similar rarefaction. Recently Schüller (1929) reported typical examples of post-traumatic osteoporosis of the skull.

Moreau-Gimelli (1912) and Delorme (1917) analyzed a total of 7400 röntgenograms which had been taken because of trauma to one or more of the extremities, and they found only 115 cases (1.5 per cent.) of atrophy of the bones. During the World War, Delorme reported sixty-two cases of osteoporosis from a series of 178 cases of trauma to bones, and later he analyzed 1350 additional röntgenograms of the same type. He concluded from these series of cases that osteoporosis existed in 50 per cent. of the cases where the trauma affected the small bones of the hands or feet; 20 per cent. after trauma to the distal phalanges and 50 per cent. of the cases in which both bones of the leg were fractured. In the cases of fracture of the bones of the forearm he concluded that one-third of the cases of fracture

of one bone and two-thirds of the cases in which both bones were fractured developed true osteoporosis. Guarini (1918) came to the same conclusions after studying a large series of röntgenograms. Such statistics, however, only show the number of cases which showed decalcification of the bones in the röntgenograms, and they do not take into consideration the equally important clinical signs of the disease.

Clinical forms.—In order to avoid all confusion with atrophy of inactivity or disuse we shall always refer to the bone atrophy that is associated with pain and vasomotor disturbances as the true osteoporosis. We distinguish four main forms of painful osteoporosis, namely: (*a*) The post-traumatic form. (*b*) The post-infectious form. (*c*) The form associated with nervous disorders. (*d*) The dystrophic form associated with disturbances of ovarian function.

In this paper we shall limit our discussion to the post-traumatic form. Sudeck differentiated between the reflex atrophy and the atrophy of inactivity, but since that time many investigators have referred to the two forms of bone atrophy as being identical.

True osteoporosis is always characterized by (*a*) *loss of motor function of the extremity,* (*b*) *characteristic changes in the röntgenograms,* (*c*) *the constant coëxistence of vasomotor disturbances,* and (*d*) *great pain.* The disturbances of the function are always more extensive than could be explained on the basis of the trauma alone, and the severe acute pain is greatly out of proportion with the local signs of injury to the tissues. If we disregard the local effect of the trauma we are still impressed by the great loss of motor function; the extreme constant pain and the marked vasomotor disturbances. Another almost pathognomonic symptom is that the pain is not relieved by immobilization, while the pain associated with simple trauma, fracture of one of the bones, or even tuberculous osteo-arthritis is definitely relieved by proper immobilization.

A very common clinical form of the disease of osteoporosis is frequently seen after fractures of the bones of the wrist or ankle which have been properly reduced. After the removal of the bandage at the end of two or three weeks the extremity is found to be swollen and discolored. Slight active or passive motion of the joint causes the patient great pain. Mechanotherapy, baking and massage make the pain more severe and the loss of function of the extremity continues to become worse. Such a clinical history is typical of true osteoporosis.

From the clinical point of view the extension of the functional disturbances beyond the area of traumatization and accompanied by constant pain which cannot be relieved by immobilization or physiotherapy is indicative of true post-traumatic osteoporosis. When the osteoporosis is limited to the bones of the foot the patient suffers very little pain while he is in bed, but he constantly complains that he is unable to bear weight on his foot because of pain.

Vasomotor disturbances.—The vasomotor and trophic disturbances ac-

companying osteoporosis were described by Sudeck. The association of osteoporosis with cyanosis; subjective and objective sensations of cold; œdema and trophic disturbances such as ulcerations, hyperkeratosis, atrophy of the skin and hypertrichosis; and constant pain have been repeatedly pointed out. Most of our cases have shown marked muscular atrophy, cyanosis of the extremity which is accentuated when the limb is placed in the dependent position, marked œdema and a thinning of the skin with a disappearance of all of the surface markings giving it a "glossy skin" appearance.

When the osteoporosis was limited to the bones of the hand most of our patients showed a hyperthermia of the affected side and occasionally this hyperthermia was very marked. In one case of osteoporosis of the bones of the shoulder the temperature of the dorsum of the hand on the affected side was 29.5° C., while that of the normal side was 28.5° C. The measurements were made with a sensitive thermo-couple. The temperature of the affected shoulder was 34.2° C. and only 33.1° C. on the normal shoulder. In other cases, however, a slight hypothermia was found.

The oscillometric index is of great value in determining the existence of the vasomotor disturbances. In seven cases of osteoporosis of the bones of the wrist the oscillations were six times stronger in the affected forearm than at the same level in the normal forearm. In one case there was no difference between the two sides. In the upper arm the difference in the oscillations is usually less marked. In many cases where a definite difference in the oscillations existed in the forearms there was little or no difference in the upper arms.

Out of six cases of osteoporosis of the bones of the ankle we found a marked increase in the oscillations in the lower third of the affected leg in five cases. The difference in the oscillations in the thighs was always very small. In the other case of osteoporosis of the bones of the ankle the oscillations in the corresponding extremities were about equal.

In six cases of osteoporosis of the bones of the shoulder we found four cases with diminished oscillations in the forearm and arm of the affected side. One case showed a marked increase in the oscillations of both the arm and forearm of the affected side. The other case showed an increase in the forearm and a decrease in the upper arm of the affected side.

In osteoporosis there is always a stage in which there are local signs of vaso-dilatation (hyperæmia and increase in the oscillations). Later in the evolution of the disease these vasomotor disturbances may disappear or become modified in the opposite direction.

Röntgenological aspects.—Two main forms of osteoporosis have been described as showing constant and characteristic changes in the röntgenograms. Sudeck named these apparently distinct stages in the evolution of the disease the (*a*) acute form and (*b*) the chronic form.

(*a*) The so-called acute form is characterized by a mottled appearance of the bone due to the irregular rarefied areas in the spongiosa. This mottling is usually most marked in the carpal and tarsal bones and in the heads of the metacarpal and metatarsal bones. In advanced cases the cortex of the small

bones becomes very thin and the outline of the individual bones is frequently lost. The lamellæ fade into one another and produce an ill-defined or homogeneous shadow in the röntgenogram.

(*b*) In the so-called chronic form the trabeculæ of the bone are very fine and sometimes difficult to recognize. The limits of the individual bones again become demonstrable, but there still remains a general loss of calcium salts. The patchy areas of rarefaction are not present. The increased strength of the bone is due to a thickening of the longitudinal lamellæ since the horizontal lamellæ remain very thin.

In cases of osteoporosis of the short bones, especially the carpal and the tarsal bones, we recognize three stages in the evolution of the disease. These three stages are (*a*) the onset; (*b*) the height of the disease; and (*c*) the reorganization. We believe that each of these three stages present characteristic röntgenological changes. The evolution of the disease from the standpoint of röntgenological changes can best be portrayed as follows: In the period of onset, which Sudeck called the acute form of the disease, there is a general mottled appearance of bones in the röntgenogram. The outlines of the bones are still easily discernible. The rarefaction continues to become more marked and more extensive. The irregular areas of rarefaction soon disappear and the bones become uniformly permeable to the Röntgen-rays. This stage of diffuse and marked decalcification marks the height of the disease. The absorption of the bone seems to spread to the neighboring bones and thus involves the heads of the metacarpals or metatarsals, then the phalanges and finally the adjoining ends of the radius and ulna or the tibia and fibula as the case may be. Marked thinning of the cortex of the bones has taken place and longitudinal streaks have made their appearance in the thinned cortex. In the region of the carpal and tarsal bones this thinning of the cortex of the bones results in the disappearance of the limits of the bones and thus transforms the entire area into a homogeneous mass which is very permeable to the Röntgen-rays. It is at this stage that a diagnosis of tuberculous osteo-arthritis is frequently made. During the period of reconstruction there is a slow reappearance of the calcium in the bones. In most cases complete recalcification never takes place. Röntgenograms taken during this stage show that the limits of the small bones have again become visible and the longitudinal lamellæ have become thickened.

The duration of each of these stages is very variable. The factor of time seems to be of little importance. In general, however, the first two stages are relatively rapid in their evolution, while the third or reconstructive stage is usually extremely slow. Professor Leriche has observed one case in which the rarefaction of the bones of the foot persisted for more than fourteen years after the initial trauma. (Fig. 1.) It is certain that after a bone becomes rarefied to any great extent it rarely regains its original density; consequently the process of reconstruction must usually be considered as incomplete. Complete anatomical restoration of the density of the bone, however, is not necessary for complete symptomatic relief.

In cases of osteoporosis of the epiphysis of long bones the first stage of evolution passes rapidly and it is unusual to observe the patient early enough to find the typical mottled appearance of the bones in the röntgenogram. There is usually a marked thinning of the cortex and a diffuse rarefaction of the entire bone demonstrable in the röntgenogram.

Post-traumatic osteoporosis of the flat bones of the skull is rare. We have observed one case in which the mottled appearance of the bones was marked. We have not observed thinning of the cortex of the bones of the skull comparable to that which we have described for the short and long bones of the body.

Clinical evolution.—It is commonly thought that osteoporosis is a self-limited disease and that after a few weeks or months recalcification takes place without leaving any deformities. Vialleton and others have expressed such views. Sudeck states that favorable evolution is only occasionally seen, and it is not the usual end-result of this disease. Kienböck (1902) and Hofmann (1916) have expressed the same opinion.

It has been our experience that after the disease has reached the climax or stage of complete decalcification, the process of recalcification begins spontaneously. Years later, however, the röntgenograms still show the thinning of the cortex of the bones and the thin lamellæ containing irregular areas of recalcification. From these facts one might get the impression that the disease heals spontaneously since it is also well known that all the vasomotor disturbances and pain frequently disappear without treatment. In the untreated cases, however, the recovery of function of the extremity requires many years and frequently during the stage of recalcification extensive fusion of the carpal or tarsal bones takes place. This ankylosis may cause great economic loss to the patient.

The following case history is presented as a typical example of the end result of osteoporosis of the bones of the foot which was allowed to continue untreated.

Case I.—A single, white woman, aged thirty-seven years, was seen in consultation by Professor Leriche in July, 1928, because of constant dull, aching pains in the left foot and an inability to bear weight on that foot. In 1914, about fourteen years previously, she "sprained" her left ankle while on a hunting expedition. The injury was apparently not very severe since she continued to walk throughout the day without much discomfort. During the night that followed she complained of moderately severe throbbing pains in the ankle-joint but no attempt was made to immobilize the extremity. She continued to walk about without aid but the pain in the ankle caused her to limp most of the time. For years after the accident she said her ankle remained "sensitive." Slight trauma to the ankle always caused great pain. During the subsequent fourteen years she consulted several physicians and almost invariably she was told she had tuberculous osteo-arthritis of the ankle. No methodic treatment had ever been instituted as she had always refused the proposed surgical form of treatment.

Physical examination in 1928 showed the patient in good general health. Local examination of the feet showed no evidence of vasomotor disturbances. There was a slight swelling of the left ankle with some tenderness to pressure over the tarso-

metatarsal joints. There was a subastragaloid ankylosis with the left foot in the talipes equinus position. Röntgenograms showed a diffuse rarefaction of all the small bones of the left foot. There was a fusion of the calcaneus and the cuboid; and between the scaphoid and the cuneiform bones. (Fig. 1.)

In this patient the osteoporosis of the bones of the foot evolved over a period of fourteen years and without ever having had the foot immobilized. During the entire time the patient suffered almost continuous pain and she was considerably incapacitated. Examples of this type are not rare. The knowledge of the slow evolution of osteoporosis

FIG. 1.—Röntgenogram showing post-traumatic osteoporosis which had evolved over a period of fourteen years. (Case 1.) Destruction of the joint surfaces between the tarsal bones and between the tarsal and metatarsal bones can be seen.

and the extensive ankylosis that frequently results should constitute an added indication for the prompt and thorough treatment of this disease.

Diagnosis.—In general painful osteoporosis can be divided into three main clinical groups depending upon the type of trauma which precipitated the disturbance. The differential diagnosis is somewhat different in each of these groups since the clinical course of the disease is frequently altered by the in-

tensity of the trauma and the extent of the injury to the bones or to the articulations.

In the case of osteoporosis which follows slight or moderate trauma to one of the poly-articular regions, wrist or ankle, little importance is usually attached to the original trauma. Gradually, over a period of weeks, the patient develops pain on moving the extremity and vasomotor disturbances of the entire extremity slowly make their appearance. Limitation of motion in the neighboring joints then becomes the outstanding symptom. The functional disability increases in severity and the pain is made worse by immobilization of the affected part. The differential diagnosis between osteoporosis and tuberculous osteo-arthritis must then be made. The röntgenological evidence of a diffuse decalcification without the slightest evidence of a specific focus is against a diagnosis of tuberculosis. However, the great majority of our cases had had a diagnosis, at one time or another, of tuberculous osteitis or arthritis.

In the second group, namely those in which the injury of the articular or peri-articular tissues is associated with a fracture of one or more of the bones of that extremity, the trauma is immediately considered as the major cause for the pain and local vasomotor changes. Since such injuries are regularly treated by complete immobilization in splints or plaster-of-Paris cases one must always consider the possibility of atrophy of inactivity. Whenever an extremity continues to show evidence of vasomotor disturbances associated with limitation of motion and pain in the neighboring or involved joints after the proper reduction of the fracture the most probable cause for such a disturbance is a diffuse osteoporosis and röntgenograms should be taken at once to establish the correct diagnosis.

In the third group, namely those in which the trauma is slight and limited to the soft parts around the joint one must rule out the possibility of a low-grade myositis or chronic teno-synovitis as the cause for the constant pain since spasm of the muscles of the extremity, slight tenderness of the muscles or tenderness in the region of the joint may be the only physical evidence of disease. In cases of osteoporosis the patient complains of great pain on motion of the extremity. The röntgenogram may confirm the diagnosis for osteoporosis in this stage of evolution shows a very definite diffuse mottling of the bones of the extremity. In this type of case the vasomotor disturbances are very slight if present at all. We believe this mild form of osteoporosis should be treated in the same manner as the more severe forms of this disease.

Pathology.—Gross examination of the porotic bones show them to have a very thin, brittle cortex and a medulla that is almost completely replaced by adipose tissue. In the later stages of the disease the vascularization is markedly reduced.

Comparatively few studies of the microscopic structure of the porotic bones have been made. Vialleton (1922) has reported histological examinations of the bones in two cases of osteoporosis. He examined the metatarsals

and the astragalus and found a disappearance of all the transverse striæ of the bones with a diminution of the longitudinal striæ (lamellæ). The atrophy was not uniform. In very late cases only a few dense, irregular acellular areas remain within the large medullary spaces. The Haversian canals become greatly enlarged without causing corrosion of the lacunæ. The cortex becomes very thin and the vessels undergo marked thickening which results in a diminished vascularization of the bone.

The mechanism of this absorption of bone has been described by Volkmann as being brought about in two different ways. First, removal by the so-called osteoclasts and, secondly, by the process of halisterisis or osteolysis of Kilian.

The first method of osteoclasis is dependent upon the phagocytic action of special cells called "osteoclasts" by Kölliker. In the cases examined by Vialleton and in our own cases, these specific phagocytes were not seen in any of the preparations which were examined.

The second method of osteolysis is based on the discovery that the disappearance of osseous tissue may take place without the apparent intervention of cellular elements. The progressive diminution of the spongy medullary bone; the enlargement of the Haversian canals; and the thinning of the cortex of bones without the presence of osteoclasts seems, to us at least, to represent more accurately the mechanism of the production of osteoporosis.

The exact chemical phenomena which bring about this disappearance of osseous tissue are still unknown. Professor Leriche has presented the various theories regarding the resorption of bone in his recent work on the normal and pathological physiology of bone which was done in corroboration with Professor Policard. The chemical examinations made by Pech (1920) and Pradal (1921) show that the mineral content of porotic bone is relatively the same as that of normal bone; consequently they conclude that there is a uniform loss of bony substance in osteoporosis and not merely a depletion of the mineral salts of the bones.

From the standpoint of the pathological picture it has been shown by Grynfeltt (1921) and again by Vialleton (1922) that the "fatty osteoporosis" described by Cornil and Ranvier is identical with the post-traumatic osteoporosis.

Treatment.—The treatment of osteoporosis has, until recently, been symptomatic and preventative rather than curative in nature. Sudeck recommended minimum immobilization and then active movement in most of his cases. Nobel and Hauser (1926) recommended heat to the point of tolerance either in the form of radiant heat or paraffin baths. They also advised massage and voluntary motion of the joints in spite of a little pain, but they emphasized that forceful manipulation under anæsthesia was definitely contraindicated. Any form of fixation with plaster-of-Paris casts or orthopædic apparatus causes increased pain to the patient. Delorme recommended treatment by thyroid and para-thyroid extracts and Pech advised heliotherapy.

All of these forms of therapy still left much to be desired. The course of

the disease was only slightly shortened and the unfavorable sequelæ were about as frequent as when the process was left untreated.

In 1924 Heyman performed the first peri-arterial sympathectomy for osteoporosis. About the same time Professor Leriche also performed a peri-arterial sympathectomy as the surgical treatment of osteoporosis. The therapeutic result was striking.

It is difficult to explain the mechanism by which this improvement is brought about since the operation of sympathectomy should be contra-indicated in a disease which is caused by hypervascularity of the extremity. The sympathectomy produces an added vasodilatation and hyperæmia. The clinical fact remains, however, that improvement can be obtained equally well in cases of osteoporosis with vaso-dilatation as well as those with vaso-constriction as the dominant clinical sign.

Since 1924 all cases of osteoporosis admitted to the clinic of Professor Leriche have been treated by sympathectomy and the results have been so gratifying that we feel that the method with our complete results is worthy of being placed on record.

Report of Cases.—The first two cases of this series are especially interesting because we had an opportunity of studying the histological changes that took place in the porotic bone after the sympathectomy.

Case II.—G. M., married, white, farmer, aged fifty-seven years, was admitted to hospital August 21, 1929, because of a swollen, painful, discolored right hand. All the joints of the right hand were stiff. The past history showed that on April 29, 1929, a cow stepped on the patient's hand. The hand became swollen and remained so in spite of vigorous medical treatment. After a few weeks the joints of the hand became stiff and a constant dull pain in the hand and wrist made its appearance. Vasomotor disturbances in the form of cyanosis and more œdema gradually came on over the entire right hand and wrist. There was an average difference of one centimetre between the circumference of corresponding fingers on the two hands. The affected hand was two centimetres greater in circumference than the normal hand. Slight motion of the thumb remained while all the other joints of the right hand were immovable. There was no evidence of fractures in any of the bones in the röntgenogram but there was a marked diffuse, irregular or patchy decalcification of the bones. (Fig. 2.) Oscillations were increased in the right forearm.

On August 23, 1929, the stellate (cervico-thoracic sympathetic ganglion) together with the intermediate ganglion of the right side were removed. Examination made several hours after the operation showed that the œdema had completely disappeared, the hand was very warm and the skin was of the normal pink color. The movements of the fingers were free and the motion was not painful. Moderate motion of the wrist. Examination on the following day showed some diminution of the movements of the fingers and wrist. During the next two days the cyanosis returned and the movements of the fingers again became limited; consequently on August 27 a peri-arterial sympathectomy of the right brachial artery was performed. This operation was followed by a return of the movements of the fingers associated with moderate hyperæmia of the entire hand and arm. The following day the patient developed an acute alcoholic psychosis and had to be transferred to the psychopathic ward. He died in acute delirium tremens about three weeks later.

At autopsy several of the carpal bones were removed from each wrist for histological examination. There were gross and microscopic changes in the bones from the right

FIG. 2.

FIG. 3.

FIG. 4.

FIG. 2.—Röntgenogram taken four months after an injury of the right hand. The patchy decalcification of the bones is characteristic of the early stage in the evolution of post-traumatic osteoporosis. (Case II.)

FIG. 3.—Photomicrograph showing the histological structure of the carpal bones during the stage when the patchy decalcification is so marked as in Fig. 2. (Case II.) (x 200.)

FIG. 4.—Röntgenogram taken six months after an extensive injury to the right shoulder. The diffuse and uniform decalcification is characteristic of the fully developed post-traumatic osteoporosis. (Case III.)

hand. The lamellæ were fairly thick. (Fig. 3.) Osteoblasts were present along the lamellæ. A few osteoclasts were found in small lacunæ in the lamellæ. Evidences of construction of bone seemed to dominate the picture. The bone marrow was very fatty and poor in myelogenous elements. Very thin-walled blood vessels were grouped around the masses of myeloid tissue. There were several islands of fibrous tissue between the lamellæ and separated from the bone by a layer of osteoblasts. It is, of course, impossible to directly attribute all of these changes toward the construction of bone to the sympathectomy. The circumstantial evidence is striking and it remains for us to carry out similar studies on a large series of cases in order to determine the exact changes brought about by the sympathectomy.

Case III.—O. K., married, white, laborer, aged fifty-seven years, was admitted to the hospital January 15, 1930, because of a swollen, painful and discolored right hand. His past history showed that on October 31, 1929, during the course of his work, he received a severe blow on the right shoulder. Fracture of the right scapula, clavicle and several ribs resulted from that trauma. About three weeks after the accident he noticed a burning sensation in the fourth and fifth fingers of the right hand. These pains were relieved by immersing the hand in cold water. The pains gradually spread to the entire right hand, forearm and shoulder. At the same time there developed stiffness of all the joints of that extremity.

Physical examination showed a slight Claude Bernard-Horner syndrome on the right side. Moderate atrophy of the muscles of the right arm. The right hand and forearm were cyanotic and œdematous. The skin of the hand was smooth and shiny. Slight increase in the local skin temperature of the right hand. Manipulation of the slightest degree of the hand or arm caused severe pains in the entire arm and shoulder. All movements of the extremity were markedly restricted. Only slight abduction of the right shoulder was possible. Complete extention of the right elbow was impossible and motion, active or passive, of the elbow-joint was very painful to the patient. Slight flexion and extention of the wrist. Pronation and supination greatly limited. Slight movements of the fingers were possible but painful. The oscillations as recorded by the Pachon oscillometer were much greater in the right than in the left forearm. Röntgenograms showed well-consolidated fractures of the right clavicle and scapula. There was a marked decalcification of the head of the humerus; of the epiphyses of the bones in the region of the elbow; and of both bones of the forearm. The rarefaction of the carpal and metacarpal bones was still more marked. (Fig. 4.)

January 18, 1930, Professor Leriche attempted to perform a resection of the stellate ganglion and the inferior part of the cervical sympathetic chain. There was an extensive sclerosis of the tissues at the base of the neck which was probably the result of the organization of an old and extensive hæmatoma. The vertebral artery was identified but it was found impossible to dissect out and identify either the sympathetic chain or the stellate ganglion. A small mass of tissue was removed from behind the vertebral artery. Histologically this tissue showed some nerve fibres with ganglion cells imbedded in a mass of dense fibrous tissue. Because of the incompleteness of this operation Professor Leriche performed a peri-arterial sympathectomy of the right brachial artery on January 21, 1930.

After the second sympathectomy the pain in the hand and elbow disappeared but the pain in the shoulder remained unchanged. The mobility of the fingers and wrist was greatly improved but the limitation of motion in the shoulder-joint remained the same.

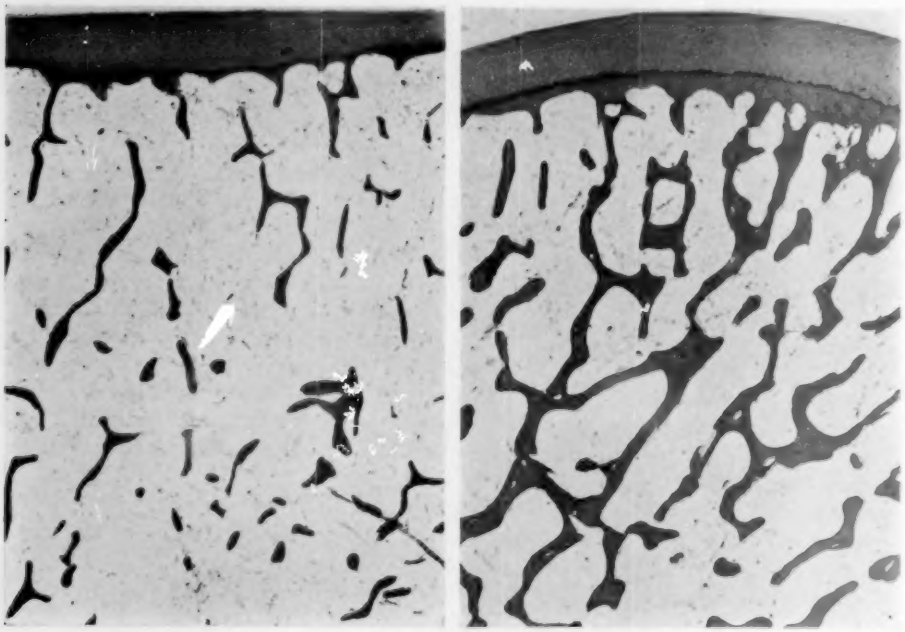
Since the pain persisted in the right shoulder Professor Leriche felt that it was advisable to attempt the removal of the superior part of the dorsal sympathetic chain on the right side. The posterior approach was used and the second rib and part of the first rib were removed. The same dense fibrous tissue was found in the region of the dorsal sympathetic chain. It was imposible to identify the individual ganglia; consequently only section of the sympathetic chain could be done with any degree of accuracy.

Histologically the tissue which was removed showed many nerve fibres and a few scattered ganglion cells imbedded in dense fibrous tissue.

Following this operation there was considerable improvement in the mobility of the shoulder-joint and a diminution of the pain in the shoulder and in the upper arm. At the time of discharge from the hospital on April 23, 1930, there was fairly good motion of the fingers and elbow but only slight motion in the shoulder-joint. The patient still complained of moderate pain in the right shoulder and upper arm.

In July, 1930, the patient returned to the hospital because of a bilateral empyema which had apparently come on after a severe upper respiratory infection. Surgical drainage was instituted, but the patient continued to become worse and finally died.

At autopsy a bilateral confluent broncho-pneumonia was found in addition to the extensive subacute empyema. We were especially interested in the condition of the



Right Left

FIG. 5.—Photomicrographs showing the difference in the histological structure of a carpal bone from the right hand, in which there was röntgenological evidence of fully developed osteoporosis, and the histological structure of the corresponding carpal bone from the opposite hand. (Case III.) Compare with Fig. 3. (x 100.)

bones in the right arm and hand; consequently the head of the humerus and several carpal bones were removed from each side for histological study. The bones of the right hand showed extensive and marked osteoporosis. The histological preparations showed fewer and thinner bony lamellæ in the bones of the right hand. (Fig. 5.) The bone marrow was almost entirely made up of adipose tissue. There was no evidence of hypervascularization in this case probably because this was a late stage of the disease. The process of osteoporosis in this case appeared to be one of pure osteolysis. Very little evidence of repair was found in any of the preparations which we examined. The lack of signs of reconstruction of bone might be attributed to the fact that complete sympathectomy was impossible due to the extensive sclerosis in the region of the sympathetic ganglia.

Osteoporosis of the bones of the hand and wrist following simple trauma

to the peri-articular or juxta-articular tissues. In this series of cases the trauma was not severe enough to cause a fracture of any of the bones.

CASE IV.—J. F., single, white, laborer, aged seventeen years, entered the hospital November 11, 1924, because of a painful swelling of his left hand with marked limitation of motion in the wrist-joint. The past history showed that during the six months prior to admission he had noticed that his left arm became fatigued after slight exertion. Two weeks before admission to the hospital he was suddenly taken with a severe pain in his left wrist while he was attempting to lift a block of iron. Motion of the wrist remained painful and he noticed moderate swelling of the dorsum of his hand.

Examination at the time of entry to the hospital showed a marked œdema of the entire left hand with almost complete fixation of the wrist-joint. There was marked

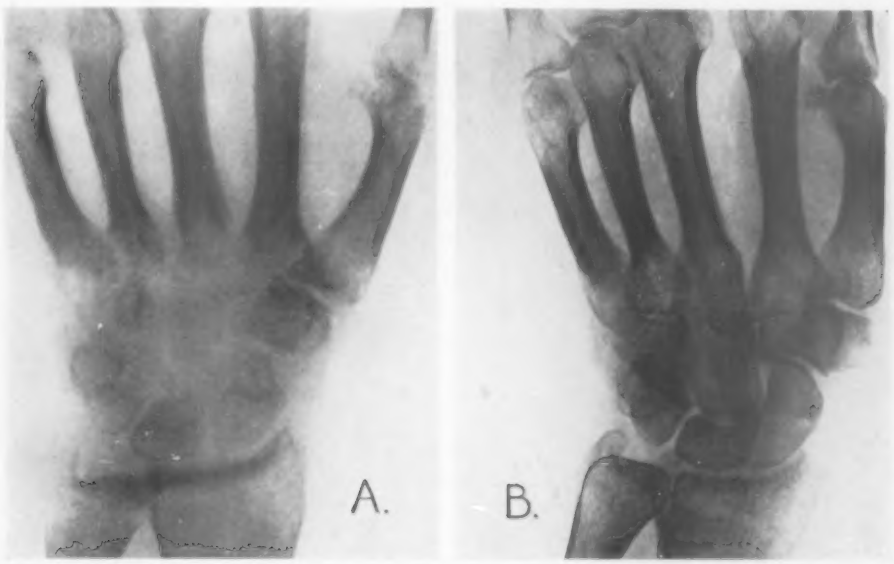


FIG. 6.—Röntgenograms showing the condition of the carpal bones before and after peri-arterial sympathectomy in a case of diffuse post-traumatic osteoporosis. (Case IV.)
A—One month after injury of the left hand.
B—Two and one-half months after the sympathectomy.

tenderness of the carpal bones to light palpation. There was a pronounced atrophy of all the muscles of the forearm. The röntgenogram showed an irregular rarefaction of all of the carpal bones causing a loss of the outline of some of the carpal bones. (Fig. 6A.) A diagnosis of tuberculous osteo-arthritis was made and the extremity was immobilized in a plaster-of-Paris case. This fixation made the pain and swelling so much greater that the case had to be removed. In December, 1924, Professor Leriche examined the patient and found that there was an increase in the vascularization of the left forearm and hand. The oscillations were greater in the left forearm than in the right. (Fig. 7.) After these examinations he felt that the entire clinical picture together with the röntgenological findings was characteristic of post-traumatic osteoporosis.

December 10, 1924, a peri-arterial sympathectomy of the left brachial artery was performed. A plaster case was then applied to the forearm. The pain disappeared soon after the operation. December 25 the case was removed and the patient was able to move his wrist freely without pain. The œdema had also disappeared. A new plaster-of-Paris case was applied and the patient was discharged from the hospital. A short time later the patient removed the case without consulting his family physician.

Follow-up examination of February 20, 1925, showed him to be entirely free from

pain or swelling of the wrist. The movements of the left wrist were normal. The atrophy of the muscles of the left forearm remained unchanged. Röntgenogram taken February 23 showed considerable recalcification of all of the carpal bones of the left

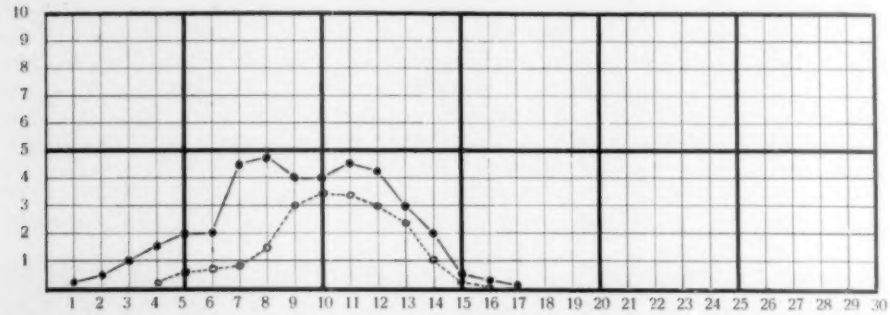


FIG. 7.—Comparison of the oscillometric readings from the forearms. (Case IV.) Readings from the left forearm are represented by a solid line while those from the right forearm are shown by the interrupted line.

wrist. (Fig. 6B.) April 20 he reported that he had been working regularly without the slightest pain or feeling of fatigue in his left arm or hand. He enlisted in the French Marine Corps April 25, 1925. In March, 1928, he reported that he was well and had no trouble with his arm or wrist.

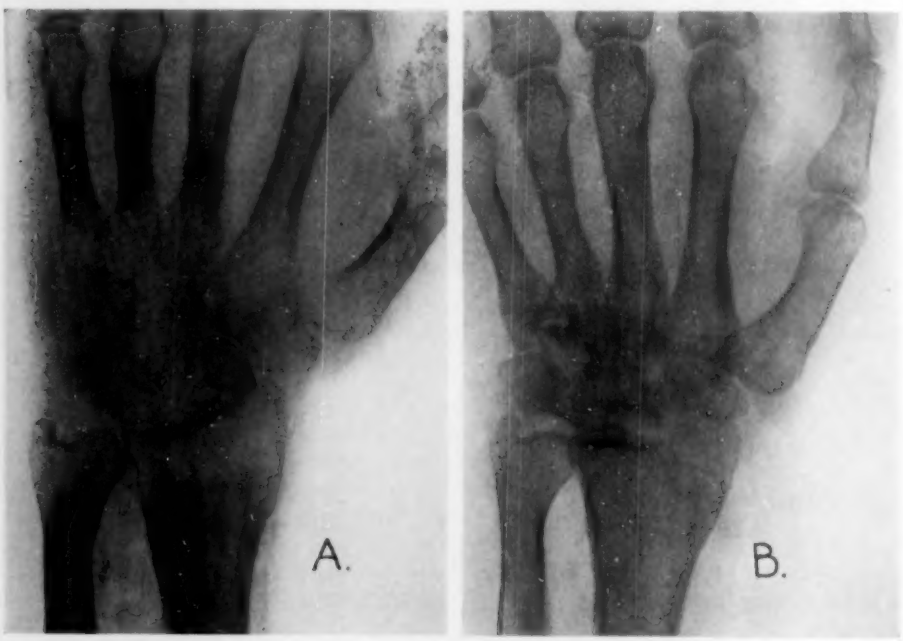


FIG. 8.—Röntgenograms showing unfavorable evolution of the osteoporosis in spite of sympathectomy. Complete ankylosis of the wrist-joint with only partial recalcification of the bones was the ultimate result. (Case V.)
A—Marked osteoporosis six months after the trauma.
B—Ultimate anatomical result five years after the trauma.

CASE V.—F. W., married, white, laborer, aged forty-seven years, entered the hospital September 11, 1924, because of painful swelling of his left hand. The past history showed that June 2, 1924, he slipped and struck his left hand against a wagon.

Immediately after this accident he began to have severe pains in the left wrist and hand. Swelling of the hand gradually came on and within two days all motion in the wrist-joint was lost. Rest, massage and hot baths failed to give relief from the pain.

On admission to the hospital about three months after the accident there was marked swelling of the wrist and cyanosis of the forearm and hand. Only slight flexion and extension of the wrist was possible. Motion of the wrist-joint was painful. Movements of the fingers were limited and the muscles of the forearm and arm were atrophied. Röntgenogram showed marked decalcification of all the bones of the left hand. The limits of the individual carpal bones could no longer be made out. (Fig. 8A.) A diagnosis of tuberculous arthritis was made and on September 24, 1924, the arm was immobilized in a plaster-of-Paris case. This immobilization made the pain much worse; consequently the case was removed. Oscillations were increased in the left forearm. (Fig. 9.) Professor Leriche was asked to see the patient. After a complete examination he felt that the clinical findings together with the röntgenological changes in the bones were typical of post-traumatic osteoporosis and he, therefore, advised a peri-arterial sympathectomy as the treatment.

November 21, 1924, a peri-arterial sympathectomy of the left brachial artery was performed. There was a marked diminution of the swelling within the first forty-eight hours after the operation. The pain on motion of the wrist disappeared. December 9,

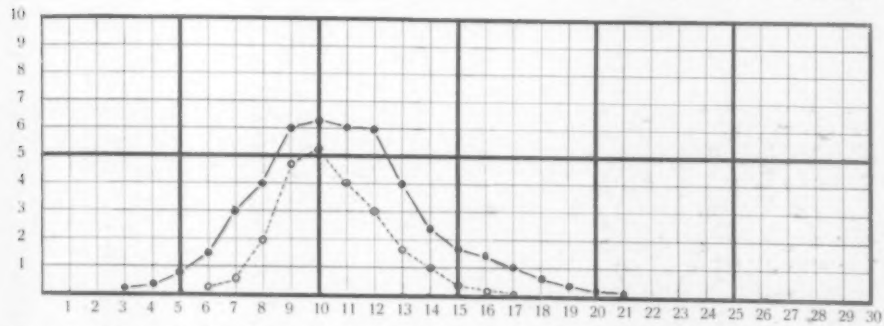


FIG. 9.—Curves showing the oscillometric readings in the right and left forearms. (Case V.) Solid line represents the left forearm.

1924, the movements of the fingers were normal, but the motion of the wrist remained limited. Another plaster-of-Paris case was applied and immobilization was continued for three months longer. At the end of that time the range of motion of the fingers was normal. No improvement in the motion in the wrist-joint. The surface temperature of the left hand was greater than that of the right. Röntgenograms showed that recalcification was taking place slowly but there was also evidence of destruction of several of the carpal bones with extensive fusion of the bones of the wrist. (Fig. 8B.) The patient was seen at fairly regular intervals over a period of more than five years after the operation. The motion of the fingers remained normal. No œdema of the hand, vasomotor disturbances of the extremity nor pain on motion of any of the joints had ever appeared since the sympathectomy. He has been able to continue his work as a laborer without interruption since the removal of the plaster-of-Paris case three months after the sympathectomy.

CASE VI.—M. Mo., married, white, housewife, aged fifty-four years. This patient entered the hospital on January 11, 1928, because of painful swelling of her right wrist. The past history showed that on October 22, 1927, while at work in the fields, she twisted her right wrist. This caused severe pain in the entire right hand associated with numbness of all the fingers. She left her work immediately and in spite of complete rest and hydrotherapy the functional difficulties increased in severity. A short time later she noticed a marked increase in the swelling of the hand with progressive stiffness of the wrist.

On entrance to the surgical dispensary (polyclinic) about five weeks after the accident examination showed an atrophy of all of the muscles of the right arm. The right wrist was swollen and deeply cyanotic. Röntgenograms showed a marked decalcification of all the carpal bones with some involvement of the distal ends of the radius and ulna and the proximal ends of the metacarpals. There was a loss of the interarticular spaces between the carpal bones. (Fig. 10A.) A diagnosis of tuberculous arthritis was made and a plaster-of-Paris case was applied to the arm and hand. The immobilization was continued for about six weeks in spite of the fact that the pain was made worse by the plaster bandage.

January 11, 1928, Professor Leriche examined the patient and in view of the circulatory disturbances, changes in the bones as shown by the röntgenograms and the clinical course of the disease he felt that a diagnosis of post-traumatic osteoporosis should be made.

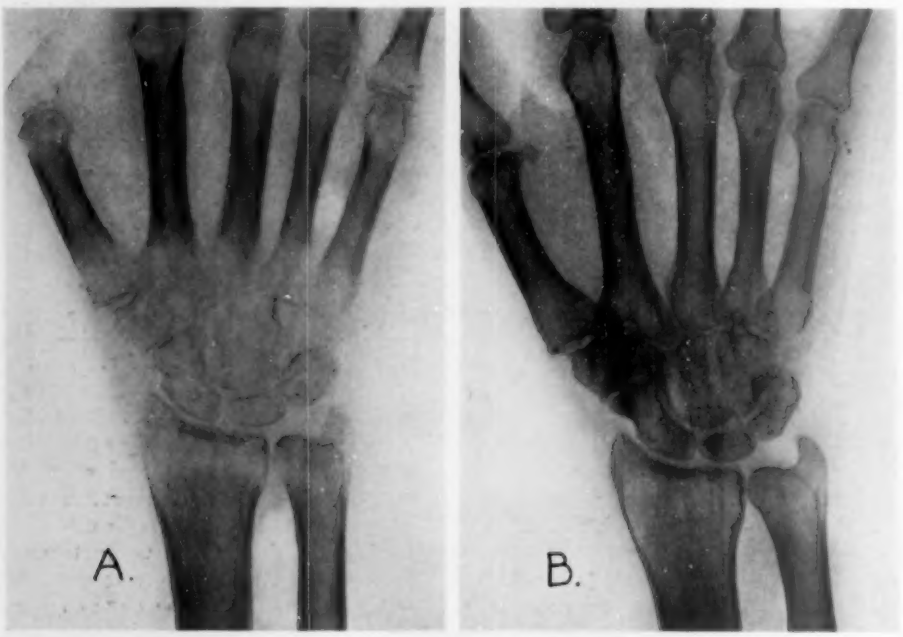


FIG. 10.—Röntgenograms showing the effect of peri-arterial sympathectomy upon post-traumatic osteoporosis which had already reached the height of the disease. (Case VI.) Recalcification has taken place very slowly.
A—Three months after simple torsion of the right wrist.
B—Two years after peri-arterial sympathectomy.

January 14, 1928, a peri-arterial sympathectomy of the right brachial artery was performed. Immobilization by plaster was continued after the operation. The pain disappeared immediately. Examination after the removal of the plaster on the fifteenth post-operative day showed an absence of the œdema and a marked increase in the motion of the fingers and wrist.

Follow-up examination April 4, 1928 (six months after the sympathectomy) showed only slight limitation of motion of the fingers and wrist. No circulatory disturbances nor œdema present. Considerable recalcification of the bones of the wrist had already taken place. February 26, 1930, twenty-five months after the sympathectomy, examination showed normal range of motion of the fingers and wrist. No pain on movement of the joints and no evidence of circulatory disturbances. Röntgenograms showed more recalcification but the process was still not complete. (Fig. 10B.) This case shows that complete recalcification is not necessary for complete symptomatic relief to the patient.

Osteoporosis of the bones of the hand following trauma which was of sufficient intensity to cause a fracture of one or more of the bones in the vicinity of the wrist-point.

CASE VII.—M. E., married, white, housewife, aged fifty-nine years, was referred to the hospital October 1, 1928, because of painful swelling of the right hand and wrist. The past history showed that on July 20, 1928, the patient fell on the outstretched arm causing a typical Colles' fracture. Immediately reduction under anæsthesia put the bones in perfect anatomical position. The entire extremity was immobilized for five weeks. Massage and "electrical treatment" were then instituted. In spite of all treatment the hand remained swollen, discolored and stiff. Röntgenograms showed a diffuse mottling of all the carpal bones with some rarefaction of the distal ends of the radius and ulna and

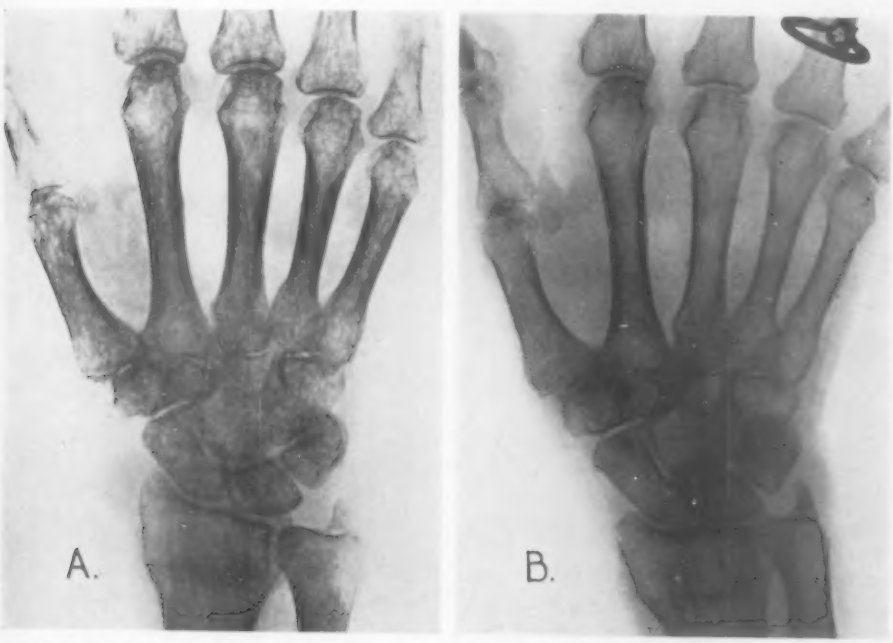


FIG. 11.—Röntgenograms showing the effect of peri-arterial sympathectomy upon post-traumatic osteoporosis which was still in the early stage of evolution. (Case VII.)
A—One month after the Colles' fracture.
B—Two months after the peri-arterial sympathectomy.

moderate mottling in the heads of the metacarpals. (Fig. 11A.) The oscillations were increased in the right forearm.

The patient was referred to Professor Leriche and he performed a peri-arterial sympathectomy of the right subclavian artery October 3, 1928. The post-operative course was uneventful. During the four weeks that followed there was a noticeable increase in range of motion of the fingers. The cyanosis and œdema had disappeared.

Repeated follow-up examinations have shown a constant improvement in the movements of the fingers. Six months after the sympathectomy, examination showed full range of motion of the fingers and the wrist. No pain on motion of any of the joints. She stated that the strength of her right hand was still below normal nevertheless she was able to do all her housework without difficulty or fatigue. Röntgenograms taken at that time showed almost complete recalcification of the bones of the right hand and wrist. (Fig. 11B.)

CASE VIII.—M. Te., married, white, housewife, aged sixty-five years, entered the

hospital November 8, 1928, because of severe pain in the right forearm associated with swelling and discoloration of the right hand. September 3, 1928, she had sustained a Colles' fracture (Fig. 12A). Reduction was done under anæsthesia and fair alignment of the fragments was obtained. The first plaster-of-Paris bandage was removed after five days and the hand was put up in abduction and extension. When this case was removed after two weeks it was found that the patient could not move her wrist or her fingers. Pronation and supination of the hand was also impossible. The patient then began to have violent, shooting pains which started in the fourth and fifth fingers and radiated to the elbow. Massage, "electrical treatments," and the application of moist heat failed to give any relief. This loss of function could not be explained on the basis of a poor reduction of the fractured bones. Slight adduction and abduction of the thumb could be done with difficulty. The entire hand and forearm were cyanotic. There was increased local heat associated with pitting œdema of the dorsum of the right hand. Oscillations were increased in the right forearm (Fig. 13). Röntgenograms showed an extensive osteoporosis of the carpal bones, the radius and ulna and the metacarpal bones. There was a marked thinning of the cortex of all of these bones. (Fig. 12B.)

November 8, 1928, a peri-arterial sympathectomy of the right brachial artery was performed. The fractured bones were manipulated slightly and then immobilized by plaster-of-Paris. The pain disappeared immediately. When the plaster case was changed November 17 the movements of the fingers was found to be much better and the œdema and cyanosis had also disappeared.

Follow-up examination March 17, 1929, over four months after the sympathectomy, showed a normal range of motion in the wrist and in the joints of the fingers. Moderate degree of pronation and supination possible. No pain on motion of any of the joints. Röntgengrams showed that the recalcification of the bones of the hand was taking place slowly. (Fig. 12C.)

Case IX.—M. R., married, white, housewife, aged forty-one years. This patient entered the hospital November 26, 1927, because of constant severe pains in her right wrist associated with œdema and cyanosis of the hand and forearm. The past history showed that October 1, 1927, she fell down a stairway and fractured the distal end of the right radius. The fracture was reduced immediately. After four weeks of immobilization in plaster-of-Paris the callus did not appear to be very firm; consequently further immobilization by a crinoline bandage was carried out. About one week later the patient began to complain of pain in the right wrist. During the subsequent two weeks the pain gradually increased in severity.

Examination at the time of admission to the hospital showed an enormous swelling of the right hand and forearm. All the joints of the fingers were stiff. Oscillations were increased in the upper third of the right forearm. Surface temperature of the dosum of the right hand was 33.4° C. as compared with 30° C. on the left. Röntgenograms showed the fractured bones to be in good position and well consolidated but there was an extensive osteoporosis of all of the carpal bones.

On November 23, 1927, a peri-arterial sympathectomy of the right brachial artery was performed by Professor Leriche. Immediately after this operation the pain in the wrist disappeared, and the œdema slowly diminished. There was a rapid return of the motion in the wrist and joints of the fingers.

Follow-up examination May 10, 1928, over five months after the sympathectomy, showed that the clinical improvement was lasting. No further pain or œdema and all circulatory disturbances had disappeared. There remained only slight limitation of pronation. Recalcification of the wrist and hand was taking place slowly.

Osteoporosis of the bones of the hand and wrist associated with vasomotor disturbances and marked spasm of all of the muscles of that extremity following trauma of slight or moderate intensity.

FIG. 12.—Röntgenograms from Case VIII showing the fracture produced by the trauma, the diffuse osteoporosis that developed subsequently, and finally the rapid recalcification that followed the peri-arterial sympathectomy.
A—Colles' fracture resulting from a fall (September 3, 1928).
B—Marked osteoporosis of all the bones of the hand two months later.
C—Recalcification almost complete four months after the sympathectomy.

Case X.—L. S., married, white, housewife, aged sixty-five years, entered the hospital June 15, 1925, because of stiffness of the left shoulder and elbow-joints associated with attacks of pain in the entire left arm. Five months previously she was knocked down by a bicyclist. The only physical evidence of injury from the fall was a small, superficial wound on the dorsum of the left hand. This wound healed promptly without showing any signs of infection. About one month after the accident she noticed stiffness of the joints of the fingers of the left hand. This stiffness grew progressively worse and soon after there was noticeable stiffness of the wrist-joint, elbow-joint and finally shoulder-joint. The patient then began to complain of sharp pains in the left hand and arm.

At the time of admission to the hospital there was a marked spasm of all of the muscles of the arm and moderate atrophy of the scapular group of muscles. The scapulo-humeral joint was immovable, and attempts at passive motion of the upper arm caused excruciating pain to the patient. Movement of the scapula permitted the arm to be raised a slight amount. Complete extension of the elbow-joint was impossible. The joints of the fingers were so stiff that the patient could not close her hand. Complete neurological examination was normal. Electrical stimulation of the nerves and muscles of the left arm gave normal reactions. Professor Leriche felt that in view of the negative neurological examination and the positive röntgenological evidence of decalcification of the bones of the left arm that a diagnostic of diffuse osteoporosis due to axone reflexes of

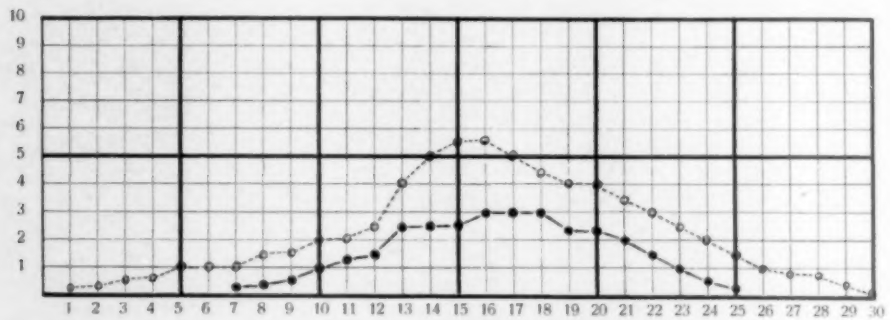


Fig. 13.—Curves showing the oscillometric readings in the right and left forearms. (Case VIII.) Solid line represents the left forearm.

traumatic origin was justifiable. He suggested cervical ramisection as the treatment of choice.

June 19, 1925, Professor Leriche exposed the cervical sympathetic chain through an incision at the base of the neck just above the left clavicle (novocaine anæsthesia). The four rami communicantes of the stellate (cervico-thoracic ganglion) were then isloated, identified and finally sectioned. That evening the constriction of the left pupil and enophthalmos of the left eyes were very marked. The surface temperature of the dorsum of the left hand was 1.9° C. higher than that on the opposite hand. The pain in the arm had disappeared. Movements of the fingers were improved. Increase range of motion in the left elbow-joint. June 28, nine days after the cervical ramisection, complete extension of the forearm was possible without pain. The left hand could be closed. Passive motion of the upper arm produced no pain but the scapulo-humeral joint remained almost completely fixed.

Repeated follow-up examinations showed a constant improvement in the mobility of the shoulder, elbow, wrist and interphalangeal joints. In December, 1930, five and one-half years after the operation, examination showed that the patient had regained the full range of motion in the shoulder-joint. The hand could be closed tightly and she had been free from all pain or discomfort in the left arm. The recovery was complete. Röntgenograms showed considerable recalcification yet all of the bones of the left arm and hand remained less dense than the corresponding bones of the opposite side.

Osteoporosis of the bones of the foot and ankle which appeared after simple trauma to the peri-articular or juxta-articular tissues. In this series of cases the trauma was not sufficient to produce a fracture of any of the bones.

CASE XI.—J. Ko., married, white, coal-miner, aged forty-five years, was brought into the hospital November 28, 1925, because of an injury to the left foot. Examination showed an extensive contusion of the left ankle but no physical or röntgenological evidence of fracture of any of the bones. The entire leg was immobilized in a splint and the patient was kept in bed. After three weeks he attempted to bear weight on the left foot. This caused so much pain that it was necessary to immobilize the foot again. The condition of the foot remained about the same and he was unable to walk for many months. He slowly improved sufficiently to bear weight on the foot. He was discharged from the hospital May 10, 1926.

He was unable to return to work because his left leg would become completely fatigued after short walks or after standing for some time. Some time later he began to have dull aching pains in the left ankle and foot. Sometime in September, 1926, he was referred to a private hospital where a peri-arterial sympathectomy of the left formal artery was supposed to have been done. Following this operation the pains in the foot and ankle grew worse and he was finally referred back to the University Hospital.

On the second admission to the surgical clinic on November 20, 1926, he complained of violent pains in the left ankle and radiating along the inner aspect of the leg. Pains were aggravated by walking. The muscles of the left leg were atrophied. There was marked cyanosis of the left foot and leg. Röntgenograms showed an extensive osteoporosis of all the bones of the left foot and ankle.

November 22, 1926, about one year after the original injury, Professor Leriche performed a left lumbar sympathetic ramisection by the extraperitoneal route. An intense hyperæmia of the left leg and foot followed this operation. The pains disappeared immediately. Within a few days the œdema and cyanosis had also disappeared. On the sixteenth post-operative day the patient walked without aid and without pain. Gradual improvement followed and he was discharged from the hospital on the twenty-first post-operative day.

Follow-up examination three months later showed complete return of the movements of the leg and ankle and no pain. Recalcification of the bones of the ankle was almost complete at that time. March 28, 1927, four months after the ramisection, the patient stated that he had no further pain and that he had returned to his regular work in the coal mines.

CASE XII.—G. K., married, white, laborer, aged twenty-seven years, was admitted to the hospital April 13, 1928, because of severe pains in the left ankle associated with marked swelling of the entire foot. On March 21, 1928, he had fallen from a roof and landed on the heel of his left foot. The foot became swollen immediately. Four days later he noticed a "black and blue" discoloration of the skin over the entire left ankle and extending a short distance up the leg. The œdema of the foot slowly diminished but he was unable to bear weight on the foot because of the violent pains in the ankle.

Examination showed moderate œdema of the dorsum of the left foot. The muscles of the left leg were slightly atrophied. Slight limitation of extension of the left foot. Pressure over the tarsal bones and over the heads of the metatarsals caused great pain. Röntgenograms showed marked osteoporosis of tarsal bones and the heads of the metatarsals. Oscillations were strong on both sides.

April 21, 1928, a peri-arterial sympathectomy of the left femoral artery was done. The pain disappeared almost immediately. Follow-up examination about six months later showed that the patient was able to walk normally and without the slightest pain. Röntgenograms showed almost complete recalcification of the bones of the ankle and foot.

CASE XIII.—E. Tr., married, white, laborer, aged twenty-five years, was referred to

the hospital October 8, 1929, because of swelling of the left ankle and an inability to walk because of pain in the left foot. In August, 1929, a beam of wood fell on his left foot. The foot became swollen and painful immediately but he was able to continue his work. About two weeks before admission to the hospital he suddenly noticed sharp pains in the left ankle. That evening on leaving the street-car he twisted his ankle and following this slight accident he was unable to bear weight on that foot. The next morning his foot was greatly swollen and very painful. Medical treatment failed to give relief so he was sent to the hospital.

On admission to the hospital there was marked œdema and cyanosis of the left foot and lower leg. The foot was warm and the oscillations were increased in the left lower leg. Pressure over the third tarso-metatarsal joint was painful. Röntgenograms showed irregular zones of rarefaction in the heads of the third and fourth metatarsal and in the cuneiform bones. A diagnosis of tuberculous osteitis was made and the foot was immobilized in a boot-type plaster-of-Paris case. The pain was not relieved by this immobilization. Rarefaction of the tarsal bones continued until the limits of these bones could no longer be seen. A diagnosis of osteoporosis was finally made.

December 12, 1929, a peri-arterial sympathectomy of the femoral artery was performed. The œdema and cyanosis disappeared very quickly. By the following day all the pain had disappeared. The movements of the toes were free and painless. Röntgenograms taken at the end of January, 1929, showed a moderate amount of recalcification.

Follow-up examination in April, 1930, four months after the sympathectomy, showed no signs of œdema or cyanosis of the left foot. The movements of the ankle were normal and painless and the patient was able to walk normally.

Case XIV.—C. H., married, housewife, aged thirty-nine years, was admitted to the hospital October 15, 1930, because of pain, swelling and limitation of motion of the right ankle-joint. In June, 1930, she injured her right heel by jumping from a chair to the floor. The ankle became swollen and painful. Röntgenograms failed to show any evidence of fracture of the bones of the ankle or foot. The swelling and tenderness of the ankle persisted; consequently she was referred into the hospital.

On examination there was œdema and cyanosis of the entire right foot. Tenderness over the entire heel of the right foot. Röntgenogram showed a small "spur" of the calcaneus which had formed since the accident. The foot was immobilized for two weeks but no relief from the pain was obtained. In November, 1930, examination showed limitation of the movements of the ankle. Cyanosis was still present. All movements of the foot were painful. Oscillations were strong in both legs and greater in the right thigh than in the left. Röntgenograms taken at this time showed a mottling of all of the bones of the right foot and ankle and a diffuse decalcification of the calcaneus. (Fig. 14A.)

November 15, 1930, a peri-arterial sympathectomy of the right femoral artery was done. Marked hyperthermia of the leg and foot followed that operation. The pain was diminished in intensity but not completely relieved. The patient was able to bear her weight on the foot several days after the operation. On the fifteenth post-operative day she was able to walk unaided but she still complained of pain in the foot. Röntgenograms showed very little evidence of recalcification.

Follow-up examination in April, 1931, showed that the movements of the right foot were normal and the patient walked normally and without pain. Only slight recalcification of the bones has taken place during these five months since the operation. (Fig. 14B.)

Case XV.—S. W., married, white, housewife, aged twenty-seven years, was admitted to the hospital June 1, 1926, because of severe pains in her right foot. Several months previously she had had a slight trauma to the right ankle but not sufficient to cause any severe pain or inconvenience at the time. Patient denied any history of venereal diseases.

Examination showed moderate œdema of the right ankle and foot with an extreme blanching of the entire distal part of that extremity. Pressure over the tarsal bones caused severe pain. Röntgenograms showed a diffuse osteoporosis of all of the bones of

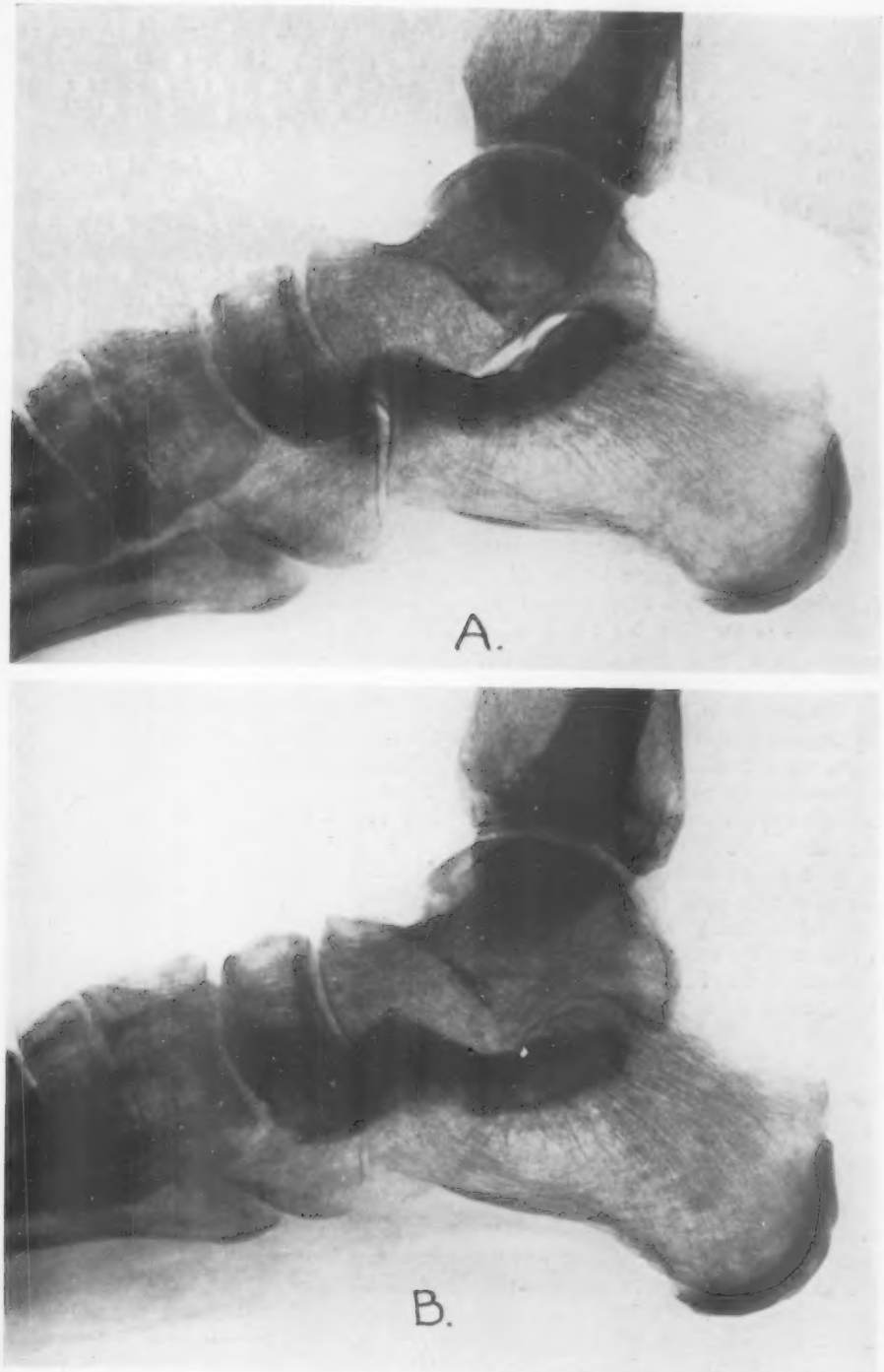


FIG. 14.—Röntgenograms showing moderate decalcification of the bones of the right foot following simple trauma to the ankle. (Case XIV.)
A—Four months after the injury.
B—Five months after the peri-arterial sympathectomy.

ankle, foot and inferior third of the right leg. Gonorrhœal arthritis was suspected but the patient denied all signs of an acute gonorrhœal infection and repeated cervical and urethral smears were negative for intra-cellular diplococci. The foot was immobilized in plaster-of-Paris until November, 1926. Röntgenograms at that time showed a more diffuse osteoporosis with thinning of the cortex of the tarsal and metatarsal bones. A diagnosis of post-traumatic osteoporosis was then made.

On November 20, 1926, a peri-arterial sympathectomy of the femoral artery was done. The foot was then again immobilized in plaster-of-Paris. The case was changed January 18, 1927, at which time motion of the ankle-joint was only slightly painful and the color of the foot had returned to normal.

Follow-up examination May 26, 1927, showed the patient to be without pain or discomfort and she was able to walk normally. In April, 1930, three and one-half years after the sympathectomy, examination showed no signs of the former disease of the ankle. She walked normally and without pain or fatigue. Motion of the ankle-joint was still limited. Röntgenograms showed moderate recalcification and fusion of several of the tarsal bones.

Case XVI.—J. B., married, laborer, aged thirty-eight years, was operated upon in May, 1926, because of an ingrown toe-nail of the right great toe. The wound became badly infected and suppuration continued for many weeks. When the wound finally healed the patient began to have sharp pains in the heel and on the lateral aspect of the right foot. Hot soaks, baking and massage failed to relieve the pain. On the contrary the pain gradually became worse and finally extended up the leg as high as the knee. The patient was admitted to the surgical clinic August 27, 1926. Examination showed a cyanosis of the right leg and foot. The muscles of the right leg showed moderate atrophy. The oscillations were greater in the right leg. The röntgenograms showed a diffuse decalcification of all of the bones of the right foot including the lower ends of the tibia and fibula.

September 2, 1926, a peri-arterial sympathectomy of the femoral artery was done. There was immediate relief of the pain in the leg and foot. The following day brought a return of some pain and this slight dull pain continued for about six weeks. The pain then gradually disappeared and there has never been a return of any type of pain or discomfort.

Follow-up examination November 14, 1928, over two years after the sympathectomy, showed normal motion of the ankle-joint. No evidence of atrophy of the muscles of the right leg at that time. Gait was normal. The right foot was decidedly warmer than the left and the oscillations were still slightly greater on the side where the sympathectomy was done. Röntgenograms showed the density of the bones of the two feet to be the same.

Osteoporosis of the bones of the foot and ankle following trauma which was of sufficient intensity to cause a fracture of one or more of the bones in the region of the angle-joint.

Case XVII.—P. Vo., married, white, housewife, aged thirty-one years. On January 11, 1928, the patient fell and twisted her ankle in such a way as to cause a typical Pott's fracture on the left. There was no displacement of the fragments according to the röntgenograms; consequently the entire foot and leg was immobilized in plaster-of-Paris. No manipulation was necessary. At the end of five weeks the plaster was removed. She was unable to walk because of severe pains in the ankle and foot. Baking, massage and diathermy failed to bring about any improvement. The pains became so severe that the patient had to go to bed since the pain was relieved when the foot was kept at rest. In attempting to walk she struck the left great toe on a chair and caused a fracture of the distal phalanyx. The röntgenograms taken on April 8, 1928, showed a very patchy decalcification of the small bones of the left foot. (Fig. 15A.) A diagnosis of tubercu-

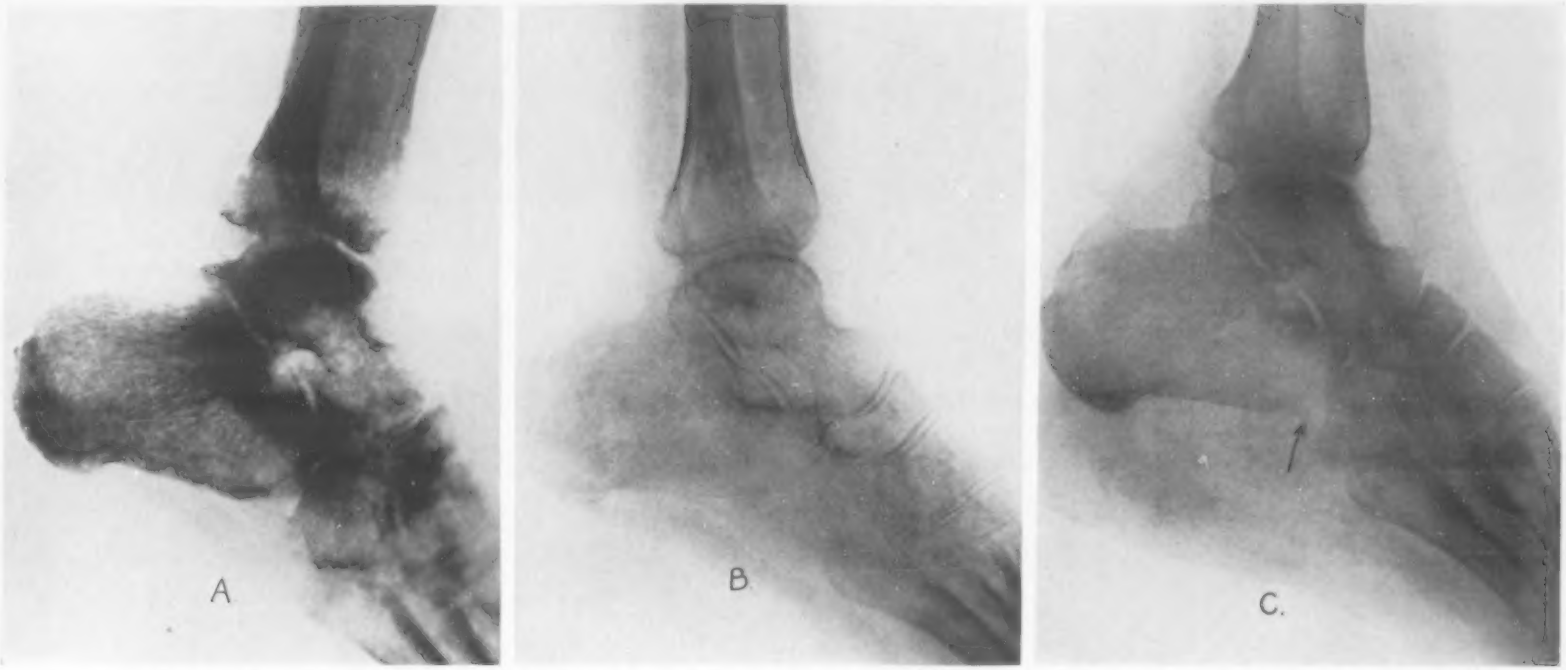


FIG. 15.—Röntgenograms showing the evolution of post-traumatic osteoporosis before and after peri-arterial sympathectomy. (Case XVII.)
A—Three months after a Pott's fracture.
B—Four months after the fracture and just before sympathectomy.
C—Seven and one-half months after the sympathectomy.

lous arthritis was made. Professor Leriche[45] was asked to see the patient in consultation. Examination showed a slight œdema of the left foot, limitation of motion in the ankle-joint and limitation of motion of the toes. Passive motion of the sub-astragaloid joint caused great pain. The röntgenograms taken in May, 1928, showed extreme decalcification of all of the bones of the left ankle. The cortex of the bones was greatly thinned but the limits of the individual bones could still be made out. (Fig. 15B.)

May 5, 1928, Professor Leriche performed a peri-arterial sympathectomy of the left femoral artery. The œdema and pain disappeared very rapidly. The movements of the foot were much freer and entirely painless at the time of discharge from the hospital May 19.

Follow-up examination July 16, 1928, about two and one-half months after the sympathectomy, showed that the patient was able to walk without aid but she still had slight pain in the left ankle-joint. Recalcification was taking place slowly but by December 18, 1928, the recalcification was nearly complete. (Fig. 15C.) The patient was again seen in July, 1929, at which time she was able to walk normally but slight pain in the ankle-joint still persisted.

Osteoporosis of the bones of the shoulder.—This variety usually presents the clinical picture of traumatic arthritis. The changes in density of the head of the humerus are much more difficult to recognize. Professor Leriche has shown that extensive changes in the articulations may take place after trauma and the subsequent hyperæmia. The results following sympathectomy are usually very striking in these cases; consequently we wish to present the following typical cases and the results which we have obtained by this method of treatment.

Case XVIII.—C. Pf., single, white, laborer, aged fifty-six years, entered the hospital October 22, 1927, because of constant pain in the right shoulder with almost complete fixation of the shoulder-joint. In May, 1926, he was struck on the right shoulder by a heavy block of lead which fell from a height of about six feet. He continued to work in spite of considerable pain in the entire shoulder. About three weeks later the pain suddenly became worse and he noticed a constant decrease of the motion in the shoulder-joint.

At the time of admission to the hospital all movements of the right arm were extremely painful. There was a slight atrophy of the muscles of the right shoulder. Loss of strength of the right hand and forearm. Only slight voluntary motion in the right shoulder-joint possible. The oscillations were greatly increased in the right upper arm. Röntgenograms showed definite decalcification in the head of the right humerus.

On October 31, 1926, Professor Leriche[45] performed a peri-arterial sympathectomy of the right subclavian artery together with an exploration of the shoulder-joint. The joint capsule was greatly thickened. The synovial membrane was villous and the cartilage of the head of the humerus was slightly roughened and a few irregular reddened areas were found in the cartilage. Biopsy of the cartilage and synovium was made.

The improvement was rapid and by November 3 most of the pain in the shoulder had disappeared and the patient was able to raise his right arm to the horizontal position without great pain. He was discharged from the hospital November 12, 1926.

Follow-up examination on December 20, 1926, showed that he was able to raise his arm to the vertical position without pain. He returned to work in December, 1926. Frequent examinations after that time showed no return of the former symptoms. He has continued to work without interruption.

Case XIX.—C. Fr., married, white, laborer, aged fifty-seven years, entered the hospital April 17, 1928, because of severe pain in the right shoulder associated with marked restriction of motion of the shoulder-joint. In 1923 the patient fell from a

bicycle and dislocated the head of the right humerus. The dislocation was reduced immediately after the accident. No further trouble until March 24, 1928, when he fell from a lumber wagon and again injured the right shoulder. The upper part of the right arm and the entire shoulder became swollen and motion in the shoulder-joint became greatly restricted. The functional disturbances gradually became worse.

Examination showed marked limitation of all the movements of the shoulder-joint. Passive rotation of the right arm was extremely painful. There was slight œdema of the right shoulder but there were no signs of vasomotor disturbances present. Röntgenograms showed no evidence of fracture of any of the bones in the region of the shoulder but there was a slight decalcification of the head of the right humerus.

Treatment by diathermy was carried out for several weeks but the symptoms continued to become worse in spite of the treatment. A few days later vasomotor disturbances were present in the upper part of the right arm. The cyanosis soon involved the forearm and hand also. There was a slight increase in surface temperature of the right forearm. The oscillations were increased in the right forearm but decreased in the upper arm. Surgical treatment by sympathectomy was proposed but the patient refused the operation and left the hospital.

June 26, 1928, the patient returned to the hospital because the pain and stiffness of the shoulder-joint had gradually but progressively grown worse. A periarterial sympathectomy of the right subclavian artery was performed on June 30, 1928. There was an immediate partial relief of the pain with considerable improvement in the motion of the right upper arm. The patient was discharged from the hospital July 12, 1928. The movements of the right arm were greatly improved but the patient still complained of moderate pain in the shoulder.

Follow-up examination in August, 1928, showed that all the former signs and symptoms had returned. In July, 1929, the pains in the right shoulder and the limitation of motion in the shoulder-joint were about the same as before the operation. In this case only moderate temporary relief was obtained from the peri-arterial sympathectomy.

Case XX.—L. J., married, white, wood-chopper, aged fifty-one years, entered the hospital January 14, 1928, because of pain in the left shoulder with limitation of motion of the left upper arm. In 1914 he injured his left shoulder. Following that accident he had constant pain in that shoulder for over three months. The pain then disappeared slowly without treatment. He remained well until December 10, 1927, when he was struck on the left side of his body by a falling tree. Two ribs of the left side of the chest were fractured by this blow and the left shoulder was badly contused. After three weeks' rest in bed he began to have sharp pains in the left shoulder. Immobilization of the arm and shoulder aggravated the pain. Marked limitation of motion of the arm gradually took place. Pressure over the peri-articular tissues of the left shoulder-joint caused severe pain to the patient. Cyanosis of the left arm and shoulder then developed. The oscillations were diminished in the upper arm on the left side. Röntgenograms showed no evidence of fracture of any of the bones in the region of the left shoulder-joint. There was a marked rarefaction of the head of the left humerus.

January 16, 1928, Professor Leriche[48] performed a peri-arterial sympathectomy of the left subclavian artery. The pains in the left shoulder disappeared immediately and the range of motion in the shoulder-joint was greatly increased. Three weeks after this operation the patient returned to his work as a wood-chopper.

Follow-up examination May 16, 1928, four months after the operation, showed no limitation of motion in the left shoulder-joint and no pain. The patient had been working regularly.

Case XXI.—C. Kr., married, white, farmer, aged thirty years, was admitted to the hospital June 17, 1929, because of severe pain in the left arm and shoulder associated with marked cyanosis of the entire extremity. February 14, 1929, he was caught between two wagons and a crushing injury of the left shoulder and chest resulted. The patient spat up blood-tinged sputum for about ten days. The pain in the left shoulder increased

in severity and the motion in the shoulder-joint became progressively more limited. The pain became so severe that he was unable to sleep. Treatment by baking, massage and diathermy was carried out for over four months without much relief of the pain or stiffness in the joint.

At the time of admission to the hospital there was atrophy of all of the muscles of the left shoulder and arm. Intense cyanosis of the entire left arm was present. The oscillations were diminished in the left upper arm. The left arm could only be raised to the horizontal position. Rotation of the arm was impossible. Passive motion of the arm caused great pain to the patient. Röntgenograms showed no evidence of fracture of any of the bones in the region of the left shoulder-joint. There was moderate rarefaction in the head of the left humerus.

June 28, 1929, a peri-arterial sympathectomy of the left subclavian artery was done by Doctor Fontaine. Intense hyperæmia of the hand and arm resulted but there was no improvement in the movements of the arm. The pain remained unchanged. Repeated follow-up examination showed no improvement followed the operation in this case.

Case XXII.—L. M., married, white, laborer, aged thirty-five years, was referred to the surgical clinic from the neurological clinic on June 3, 1929, because of severe pain of the causalgic type in the scar of a war-wound in the right fronto-temporal region, together with severe pains in the right shoulder and limitation of motion of the right upper arm. In 1918 he was wounded by a shrapnel. The wound was in the right fronto-temporal region and it extended down to and included the right eye. The eye was removed immediately. Suppuration of the wound lasted for months but finally healing took place and a large irregular scar remained.

In March, 1929, he fell from a wagon and injured his right shoulder. Following that injury he gradually developed pain in the shoulder and arm with progressive limitation of the motion in the shoulder-joint. At about the same time he began to have pain in the scar on the side of his head. The pains in the scar increased in severity very rapidly and by June, 1929, they were so severe that he was unable to sleep.

Examination showed a marked cyanosis of the right arm and hand. Active rotation of the right upper arm was impossible. All active or passive motion of the right arm caused great pain to the patient. The oscillations were diminished in the right forearm.

Because of the intolerable pain in the scar on the side of the head it was felt advisable to treat that disturbance first; consequently on June 13, 1929, the right superior cervical sympathetic ganglion was removed by Doctor Fontaine. The pains in the scar ceased immediately after the operation. The pains in the right shoulder seemed to have been made worse by this operation upon the cervical sympathetic chain. Röntgenograms of the shoulder showed no evidence of fracture of any of the bones but there was a marked rarefaction of the head of the right humerus.

June 30, 1929, a peri-arterial sympathectomy of the right subclavian artery was performed by Doctor Fontaine. Following this operation the pain disappeared immediately but there was only slight improvement in the motion of the right upper arm.

Follow-up examination on January 10, 1930, showed no further improvement in the motion of the right arm but all the pain in the arm, shoulder and scar on the side of the head had been completely relieved by the operations. In spite of the limitation of motion of the right upper arm the patient was able to return to work.

SUMMARY

After an analysis of the results obtained in all of the cases of post-traumatic osteoporosis admitted to the surgical clinic of Professor Leriche since 1924, it is evident that the sympathectomy has added greatly to the comfort of the patient as well as having brought about the restoration of function much quicker than could possibly have taken place without the

operation. However, in cases in which there is an advanced stage of the disease, the sympathectomy frequently gives only partial relief of the pain and little or no improvement in functional disturbances.

In the group of osteoporosis of the bones of the wrist we have reported nine cases. Two of these cases died from other causes shortly after the operation. Six of the remaining seven patients were completely relieved of all symptoms and functional disturbances. In one case of extensive osteoporosis of long standing the sympathectomy relieved the pain, but almost complete ankylosis of the wrist-joint was the ultimate anatomical result.

In the group of osteoporosis of the bones of the ankle we have reported seven cases. Four of these cases showed prompt and complete recovery. Two of the cases showed marked improvement in the function of the extremity, but a slight amount of pain persisted after the sympathectomy. One case has been operated upon recently; consequently no comment as to the end-result can be made at this time.

In the group of osteoporosis of the bones in the vicinity of the shoulder-joint we have reported five cases. Two of these cases showed prompt and complete relief after the sympathectomy, while the other two cases showed only slight improvement following the operation. One patient was completely relieved of the pain, but the stiffness of the shoulder-joint remained unchanged.

The type of operation upon the sympathetic nervous system that is to be used is determined entirely by the extent of the osteoporosis. In cases where the disease is limited to the bones of the ankle or wrist simple peri-arterial sympathectomy of the brachial or femoral artery, as the case may be, is sufficient. However, when all of these bones of an extremity are involved, the operation of sympathetic ramisection or ganglionectomy should be done. The surgical technic for these various operations is now well established.

CONCLUSIONS

(1) Post-traumatic osteoporosis is a disease entity with characteristic röntgenological changes in the three main stages in the evolution of the disease.

(2) Post-traumatic osteoporosis which is left untreated usually results in an ankylosis of one or more of the joints in the region of the porotic bones.

(3) Operations upon the sympathetic nervous system offer a rational and effective surgical treatment for this disease entity.

(4) Cases of post-traumatic osteoporosis treated by sympathectomy during the initial stages of the disease respond quickly and the undesirable sequelæ of the disease are prevented.

(5) Peri-arterial sympathectomy is usually sufficient for cases of post-traumatic osteoporosis which is limited to the distal part of the extremities. Cervical and lumbar sympathetic ramisection should be reserved for the extensive forms of the disease.

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IRRADIATION IN CARCINOMA OF THE BREAST

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Hoffman places carcinoma of the breast as fifth in the line of cancer death-causing lesions and reports an increase in such cases during the past ten years. The value of irradiation in the treatment of cancer of the breast is still a mooted question; during the past few years there have been adverse reports from qualified clinics, as well as most favorable reports where it is used as a necessary adjunct to surgery or employed alone as the treatment of choice.

Harrington, reporting on breast cancer cases treated at The Mayo Clinic, is of the opinion that irradiation adds nothing of value to the surgical treatment of cancer of the breast. On the other hand, Smith and Bartlett, of Boston, in their study or malignant tumors of the breast, state there is a distinct benefit following pre-operative and post-operative irradiation. In 1929, Pfahler and Widmann, from a study of a great many cases treated in Philadelphia, conclude that X-ray therapy is of value in all cases of cancer of the breast. More recently, Pfahler and Parry in reviewing more than 900 cases from their private practice conclude, because of the theoretical, experimental and clinical proof of its value, that irradiation is advisable and state that from their experience over a period of twenty-five years they have found pre-operative and post-operative irradiation of distinct benefit. In thirty-nine cases of operable carcinoma of the breast treated by irradiation alone they had a five-year cure factor of 85 per cent. Levine, who had a large number of advanced cancer cases to deal with in the New York City Cancer Institute, definitely states that irradiation is a necessity in treating these conditions and that often non-operable cases were made operable by irradiation. Lee, in 1928, reports a definite value in the use of irradiation in the treatment of cancer of the breast. He decribes the results of treatment in cases where it was used either pre- and post-operatively by radiation alone or with palliative surgery, and expresses his belief that in inoperable cases irradiation ameliorates the condition and prolongs life. Ward states that much can be done with irradiation in inoperable cases to relieve suffering while controlling the progress of disease.

Certain it is that in cases of metastatic involvement irradiation is of real value. Lenz and Fried found it of great ameliorative worth in a large number of cases such as are found in a home for incurable cancer cases like the

Montefiore Hospital. In the case of six male patients treated at Bellevue Hospital and reported by Rosh, we believe that irradiation definitely hindered the malignant growth and prolonged the life of the patients. Trout and Peterson are of the opinion that the results in the treatment of breast cancer cases are markedly improved with irradiation following radical surgery, and they report that a recent questionnaire showed 89 per cent. of the surgeons in accord with this opinion. Similarly, Bevan, who has had a great deal of experience in breast cancer work, favors post-operative irradiation as a necessary means of treating carcinoma of the breast.

If the success of surgical procedures and the operability of breast cases depends on how early the involved breast is recognized, then in estimating the value of such statistics, these factors must also be likewise considered in a résumé of results from radiated cases.

In a free hospital or clinic such as Bellevue, where patients are rarely received in an early stage, and most often in an advanced condition of the disease, patients cannot be chosen according to their economic status or the extent of their disease as is the case in those institutions whose only surgical methods of treatment are considered of value and as to which favorable statistics are reported. In these latter institutions, most of the cases naturally are of the early-stage type, as they must be if they are to be considered operable. In a large general municipal hospital, however, where the patients are drawn from a plane of life in which the economic struggle for existence is very severe, those applying to the clinic for relief usually do so when their normal daily duties are interfered with and when the local lesion which presents itself has appeared late in the course of the general disease and thus it is seldom that a tumor of the breast is noted in an early stage. Usually it is the result of advanced involvement that calls attention to the offending lesion and forces the patient to apply for relief despite her economic status, which prevented her coming to the hospital when the condition first began. This economic factor has important bearing on the type of tumor growth seen and any statistical data must therefore take cognizance of it. In such cases it is that we must look for a more rapid extension from the original growth and in which irradiation, which tends to limit this advancement of the disease, is of real value.

As the extent and duration of the tumor affect the operability and the post-operative prognosis, so too they must affect the curative power of radiation therapy. We have regarded the presence of supraclavicular metastases as contraindicating radical mastectomy and the presence of pulmonary and skeletal metastases as precluding the possibility of any surgical procedure, except in cases of ulcerated foul breasts when a simple mastectomy may be done. Stubenbord reports that in the 108 cases at the New York Hospital during a period of fifteen years most of them had lymphatic gland involvement.

Not all breast cancer cases coming to Bellevue Hospital are referred for irradiation, but during the period 1924–1930, radiation therapy was requested

in 270 cases. Due to the low economic status of such patients it has not been possible to keep in touch with 123 of them after treatment was administered, and so while for purposes of record we have herewith reported those cases adversely, some may still be alive, although our records show patients alive only up to their last visit to our clinic. The frequent change of domicile customary among the poor makes it quite impossible to insure any record otherwise in most of these cases. Up to the present time X-ray therapy in carcinoma of the breast was deemed of most value after operation. Now, however, many therapists believe pre-operative irradiation of more value and, based on our experience for the past two years, we are of the opinion that pre-operative irradiation is of exceptional value in all cases. This assumption is based on the direct action of the irradiation on the malignant cells which are either killed outright or hindered in their growth. For it has been shown time and again that growing malignant cells are most vulnerable to intensive irradiation. Irradiation also stimulates the defensive processes of normal tissues which thereby inhibit extension and further growth of the malignant cells. It likewise definitely limits tumor growth to the tissue already involved, so that its removal may be safely accomplished. Lee definitely states that healing is not retarded by pre-operative irradiation.

On the third surgical service at Bellevue Hospital, we have pre-operatively irradiated all operable breast cases since 1929; there were twelve such cases and no difficulty has been experienced in healing in any of them.

Of the 270 cases referred to the Bellevue Radiation Department for treatment during the period 1924–1930, 264 were females and six males. Of these, 215 were referred for post-operative irradiation, twelve for pre-operative and post-operative irradiation, forty for irradiation alone and three for irradiation and operation. As shown by Lee and Tannenbaum, inflammatory cancer cases do very badly with surgical therapy and we, too, have found it better to treat such cases only with palliative radiation. Two cases were treated with endothermic removal of the involved breast and then irradiated.

In our series most cases appeared in married women and especially in those who had had children. This is in accord with the findings of Stubenbord, but is contrary to the report of Summers who states that lactation hinders carcinoma growth and that in Pennsylvania most cases occurred in single women. There were 228 married and thirty-six single women, and six married men. Of the married women 157 had had one or more children; 142 had nursed their children and 113 had no children. In two cases pregnancy followed radical removal of one breast with post-operative X-ray therapy. Of the total number 255 were white and fifteen were colored patients; fifty-two were Jews.

In our series it appears that there was little difference in the predilection of the cancer site, for the right and the left breast were nearly equally involved. In 139 cases the right breast was involved, in 121 the left, and in ten cases both breasts.

As to the age when the patients reported for treatment, most of them

were between the ages of thirty to forty-five years, somewhat earlier than Stubenbord's patients. The number of cases grouped according to years, was as follows:

20–30	31–40	41–45	46–50	51–60	61–70	71–80
9	50	48	40	66	49	8

Only thirty-seven gave a history of trauma to the breast, yet but eight reported to the clinic with the duration of symptoms of less then one month. The others had symptoms varying from one month to more than five years before reporting to us for aid. They are grouped as follows:

Months			Years			
0–1	1–6	6–12	1–2	2–3	3–5	5 plus
8	72	68	55	32	17	18

With regard to the extent of the lesion, in no case was the condition limited to the breast, all cases having extension beyond the local lesion. This secondary involvement affected either the local or adjacent lymphatics or the skeletal and visceral structures. The secondary involvements occurred most frequently in the lymph nodes of the axilla on the same side as the lesion; in ten cases both axillas were affected. In thirty-five cases the supraclavicular glands of one side were involved and in seven both supraclavicular spaces. The secondary involvements were as follows:

Two hundred cases involvement of one axilla; ten cases involvement of both axillas; thirty-five cases involvement of one supraclavicular area; seven cases involvement of both supraclavicular areas; eighteen cases involvement of opposite breast; twenty-three cases involvement of the skin; nineteen cases involvement of the pleura; eleven cases involvement of the lungs.

The number of cases with skeletal metastases were not so numerous as those reported by Lenz and Fried; there were but thirty-seven cases so involved. In twenty-two cases most of the skeleton was involved, including the skull, in nine cases the spine alone was involved, the pelvis in four and the sternum and hips in one case respectively. The viscera were involved in seven cases, six in the liver and one the stomach. Three cases of brain metastases occurred; two were proven by autopsy and one of them was reported by Schweitzer in 1931. From the pathological standpoint there were: three cases of Paget's; one case of giant-cell sarcoma; fourteen cases of scirrhous carcinoma; 252 cases were carcinoma of the adeno or duct-cell type.

The time in which treatment was carried out was as follows:

1924	1925	1926	1927	1928	1929	1930
38	22	28	49	36	51	47

Results of treatment showed sixty-two of all the cases alive and well at the present time. In calculating the period of time alive following treatment the time was figured up to the last report to the clinic. In as much as many of these patients fail to come back to the clinic on account of economic conditions, no doubt some of the patients are alive beyond the time shown

in our schedule. There are eighty-five known dead. The length of life after treatment of the known living cases is as follows:

Year	Cases Treated	*Known to be alive after treatment*							
		7 yrs.	6 yrs.	5 yrs.	4 yrs.	3 yrs.	2 yrs.	1 yr.	Less than 1 yr
1924	38	4	1	3	2	1	6	7	14
1925	22		1	1	1		4	2	13
1926	28				6	2	5	4	11
1927	49				9	6	4	18	12
1928	36					9	4	9	14
1929	51						18	13	20
1930	47							38	9

From our records we are inclined to believe with Lee that the clinical index of malignancy is of more value than the histological findings in our cases. The older patients live much longer following treatment.

Of the twelve pre-operatively irradiated cases ten are alive, and it is our opinion this method of procedure is of real value in operable cases and that operation is not made more difficult or hazardous.

Treatment with radium and X-rays alone was used in thirty-nine cases. One case treated by irradiation alone was subsequently operated upon.

The employment of irradiation alone as the treatment for cancer of the breast has as yet been the procedure in only a few instances. Keynes, of London, believes that if cases to be so treated are chosen with the same criteria as breast-operable from the surgical standpoint, radiation will give equally good results. Lee suggests that irradiation be given first choice in selected operable cases, and, when properly carried out according to the method in use at Memorial Hospital, will give good results. A method in use at the New York City Cancer Institute was reported by Cutler in 1931. The reason to treat a breast lesion by irradiation was not its operability from the standpoint of the local tumor growth but because of the general physical involvements in the patient, such as severe cardiac, pulmonary or associated lesions. In some of our cases age was the factor which barred surgical procedure. From the cases treated it is our considered opinion that such irradiation therapy is of value in selected cases.

The technic which we believe will give the best results is a combination of external irradiation over the local area involved and the adjacent lymphatic drainage tissues, together with interstitial treatment with properly designed and filtered radium needles or tubes, as described by Kaplan in 1931, by Adair in 1930, and recently also by Lee and Pack. As in all surgical procedures, the technic employed must be scientifically carried out by those trained in such work; mediocre attempts at irradiation are equally as harmful as mediocre surgery.

Summary.—A report is made of 270 breast cases treated by the Radiation Therapy Department during the period of 1924–1930.

In our service post-operative irradiation is deemed of value.

Pre-operative irradiation, in our experience, is of distinct value in prolonging the life of the patients and preventing recurrences.

Radiation therapy alone has proven of value for inoperable cases and in several chosen operable ones.

Judgment in choosing cases and proper technic in treatment are essential for attaining good results.

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SARCOMA OF THE STOMACH

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The object of this communication is to place on record two cases of sarcoma of the stomach. Sarcoma is a comparatively unusual form of neoplasm arising from the gastric wall. Ewing estimates that sarcomata constitutes 1 per cent. of all stomach tumors. In his review of cases in 1920, Haggard found that 244 cases had been reported, of which 107 came to operation, the diagnosis in the remainder having been made by post-mortem. In 1930, D'Aunoy and Zoller were able to collect 335 cases. They agree that sarcomata form 1 per cent. of all cases of stomach tumor. Oschner and Smithies, in their analysis of 921 cases of stomach tumor, found four sarcomata. Anschutz and Konjetzny believe that sarcoma of the stomach is more frequent and constitutes about 2 per cent. of all gastric neoplasms.

The pathology of these cases is extremely interesting. From a gross pathological viewpoint, they may be divided into three classes: first, the intra-gastric; second, the extra-gastric; and third, a gross sarcomatous infiltration, resembling linitis plastica.

Schlessinger agrees to the classification of extra-gastric, submucosal and mucosal or infiltrating. The extra-gastric, according to all observers, occurs most frequently. The pylorus is not, as in carcinoma, the seat of predilection, so that obstruction is a rare symptom. However, Schlessinger had a case of this kind. According to Kauffmann, the extra-gastric and submucosal varieties are of long duration and not of high-grade malignancy. Metastases occur in about one-third of the cases untreated by operation, and are most frequently found in the abdominal lymph-glands, although the liver and the more distant organs may be involved. Of seventy cases collected by Bertrand, there were four intra-gastric, thirty-two infiltrating and thirty-one extra-gastric. The intra-gastric, originating in the submucosa, spread under and lift the mucosa, involving a varying area of the stomach. They may become pedunculated as in Case I. After they have been present for a certain length of time, an ulceration of the mucosa may develop, resulting in necrosis and hæmorrhage. Ewing believes that these cases are really myosarcoma and originate in a sarcomatous change in a fibromyoma of the stomach, very much in the same manner in which sarcomata may result from uterine fibroids. This, however, has not been borne out by many other authors, as the microscopical appearance in most of these cases is a typical fibro- or spindle-cell sarcoma. This form may be comparatively non-malignant and may run a long course.

The infiltrating sarcomata are also usually of the round-celled variety and involve a large part of the stomach, frequently resulting in a condition resembling linitis plastica. In these cases a microscopical section is necessary to differentiate them from carcinoma. The extra-gastric variety, which are either fibrosarcoma or spindle-cell sarcoma, are the most interesting of the group. They originate in the subserous connective-tissue layer and spread from the stomach, frequently involving so little of the stomach wall that they become pedunculated, the involved area of the stomach forming the pedicle. They may reach a large size. A case reported by Deaudinsky weighed six kilos. In form, they are usually spherical or nodular, and frequently show hæmorrhagic areas and cystic degeneration. These tumors arise either from the greater curvature or the posterior surface of the stomach, and spread between the layers of the gastrohepatic or gastrocolic omentum. It is extremely difficult to make the diagnosis in this type of case, and they are often mistaken for Banti's disease, tumor of the kidney or mesenteric cysts. One of the most striking features of these extra-gastric sarcomata is that on first opening the abdomen they appear completely inoperable, because of their omental covering and their adhesions, but after careful dissecting, a large number of these tumors can be successfully removed. This is particularly true, as, unlike carcinoma, the line of demarkation between the tumor and the normal stomach is well defined and sharply outlined. As the cases are comparatively benign, there is a large percentage of recoveries.

Lymphosarcoma of the stomach may occur as metastasis in any form of lymphoblastoma, secondary to a primary lesion elsewhere. Ewing has described them in Hodgkin's disease, the various leukemias, melanotic sarcoma and in generalized lymphosarcoma. These cases, of course, have no surgical significance.

Symptoms.—The most instructive single series of cases are the fifty-four which were studied at The Mayo Clinic in twenty years. In these a positive microscopical diagnosis was made in forty-five and a gross pathological diagnosis in the remaining nine. The average age of the Mayo cases was forty years, the youngest ten years and the oldest sixty-seven years. In most of the collected series of cases the greatest prevalence is in the fifth decade.

The duration of the disease before the advice of a surgeon is sought is frequently of long standing, usually over a year. Pain was present in nineteen cases, dyspepsia in twenty-three, bleeding in sixteen, and tumor in twenty-six. The tumor was situated in the mid-epigastric line in thirteen, to the left of the epigastrium in eleven, and to the right of the epigastrium in two cases. Bleeding is frequent, and may take the form of either hæmatemesis or melæna. These hæmorrhages are at times massive, and recur during the entire course of the disease. A palpable tumor is present in over half the cases, and in the extra-gastric variety may take any location, and may be mistaken for other diseases. For instance, in two of Mayo's cases and one to be reported below, the diagnosis of Banti's disease was made. This diagnosis, of course, is favored by the secondary anæmia, due to repeated gastric hæmorrhages. This is particularly confusing as gastric hæmorrhage is a frequent early symptom of Banti's disease.

A case somewhat of this nature was reported by Schiff.[10] The patient was admitted to the General Hospital with an acute illness. He had chills and fever. A large tumor

mass was discovered occupying the site of an enlarged spleen. In spite of the X-ray diagnosis of gastric ulcer, the diagnosis of splenic abscess was made. At operation a sarcoma of the posterior surface of the stomach was discovered, which had ulcerated into the lesser peritoneal cavity, forming a large abscess. Microscopical diagnosis of leiomyosarcoma was made.

Of the fifty-four cases reported from The Mayo Clinic, the clinical diagnosis of carcinoma was made in thirty, abdominal tumor in eight, ulcer in five, benign tumor of the stomach in three, Banti's disease in two, and sarcoma of the stomach in two. With the increasing interest in these cases it is possible that a correct diagnosis may be more frequently made. The treatment is, of course, surgical, as no other form of therapy seems to be of benefit.

Of the fifty-four cases reported from the Rochester Clinic, thirty-eight were operable, a very much larger percentage than is found in cases of carcinoma of the stomach which come to operation. Of those cases operated, there were twelve cures for from one to nine years.

Freeman reported a very interesting case of inoperable lymphosarcoma. The diagnosis was proven by operation, and the patient subjected to X-ray treatment and was alive two years after exploration. This is, of course, possible only in cases of lymphosarcoma, as they are most amenable to X-ray therapy, owing to their embryonal structure and their consequent radio-sensitivity. The fibrosarcoma are resistant to X-ray, and very little can be accomplished from X-ray therapy.

Unlike carcinoma, large resections are not so important, as the tumor is sharply demarkated from the normal stomach. If the tumor can be removed with a generous portion of the stomach, leaving sufficient stomach remaining to close in continuity, a typical gastric resection is not only unnecessary, but needlessly dangerous. The mortality of those cases operated on at the Mayos' was 13 per cent., slightly lower than that of operations for carcinoma of the stomach. The records of the two cases recently under our observation are as follow.

Case I.—Mrs. C. B. P., aged forty-two years, was admitted to the Jewish Hospital, August 10, 1930, complaining of abdominal distress. She states that she has not been in good health for four years, and has suffered from abdominal pain and indigestion. During this period she has had four gastric hæmorrhages, and has frequently noticed blood in the stool. Her left breast was amputated thirteen years ago at the Good Samaritan Hospital. *Microscopical Diagnosis.*—Fibrocarcinoma. Two years ago, an X-ray examination was made with the resulting diagnosis of duodenal ulcer. She has had numerous courses of Sippey treatment. She is weak, short of breath and very pale. Her blood-pressure is 140/88, the pulse slow. The abdominal examination shows a rigidity and slight tenderness in the upper left quadrant. A mass is felt under the left rib, which moves with respiration. The size of this mass is impossible to estimate.

A skiagraph (Fig. 1) showed a large circumscribed filling defect in the middle of the stomach, due to a tumor which arises from its anterior wall.

August 12, 1930, a transfusion of 500 cubic centimetres whole blood was given. August 13, 1930, the abdomen was opened through an upper mid-line incision, and a fairly large tumor mass was discovered, springing from the anterior wall of the stomach and projecting into its lumen. The tumor was almost pedunculated. It was removed with a generous portion of the surrounding stomach wall. The stomach was closed in layers, and the abdominal wall closed by wire sutures. There were no post-operative complications. The pathological microscopical diagnosis was fibrosarcoma.

Before discharge September 6, 1930, an X-ray examination revealed a stomach

which showed slight deformity in its mid-section. A blood examination revealed erythrocytes, 3,610,000. Hæmoglobin, 40 per cent.

Case II.—F. P. C., male, aged sixty-one years, was admitted to the Jewish Hospital, November 7, 1931. In August of this year the patient had an attack of pain which was diagnosticated as pleurisy, and responded to rest and medical treatment. At that time X-ray examination revealed an infection of the left ethmoidal sinus, for which a drainage operation was performed. Gastro-intestinal symptoms had never been present. October 20, 1931, he suddenly became weak, nauseated and vomited about eight ounces of blood. The rest of the history is essentially negative.

Abdominal examination shows the liver palpable two fingers-breadth below the right costal margin. A mass can be palpated which extends up under the costal arch and seems to take the position of an enlarged spleen. The tumor is freely movable. As nearly as can be estimated the size is that of a child's head. The blood examination is given in detail, as it shows why the diagnosis of Banti's disease was made.

Fig. 1.—Case I.

Fig. 2.—Case II.

Hæmoglobin, 45 per cent. (Sahli); white cells, 8,600; red cells, 3,020,000; reticulocytes, 40,000; platelets, 224,000; clotting time, 2.5 minutes; bleeding time, 4.5 minutes; clot retraction, normal.

A skiagraph (Fig. 2) showed the stomach displaced to the right and forward by a large circular mass in the region of the left hypochondrium. The posterior wall of the stomach is deformed apparently due to adhesions between it and the tumor. Though the tumor occupies the region of the spleen it was not thought to be due to splenic enlargement, because the mass was circular instead of being oval, as is the case with splenic enlargement. Furthermore, the mass was adherent to the stomach, which does not occur with enlargement of the spleen. It was therefore concluded that the tumor was either a pancreatic tumor or a retroperitoneal tumor, but not a spleen.

The combination of enlarged spleen, hæmorrhage from the stomach, slight enlargement of the liver and the blood-picture, led to a diagnosis of Banti's disease in spite of the X-ray report.

A transfusion of 500 cubic centimetres of whole blood was given November 16, 1931, and the patient operated upon November 17, 1931. Under ethylene anæsthesia, a mid-line

incision was made. On opening the abdomen, a large tumor mass could be seen, covered by the greater omentum. The omental vessels were enormously dilated. An incision was made through the omentum and the tumor still found covered by the gastrohepatic omentum. This was separated and the surface of the tumor exposed. It was found to be nodular and apparently of sarcomatous nature. Frozen section at this time showed spindle-cell sarcoma. As the extraneous blood supply was controlled and the tumor itself was not particularly vascular, an attempt was made to remove it. After further tying the large vessels of the omentum, the tumor was separated by manual manipulation from the diaphragm, to which it was adherent by tenuous avascular adhesions. After this separation the entire tumor was dislodged from its bed. As it was dislodged the normal spleen was seen to detach itself from the lower pole of the tumor and drop back into the abdomen. In its development the tumor had taken the place of the spleen, dislodging the spleen before it. The spleen fitted on the lower end of the tumor, much as the suprarenal fits on the upper pole of the kidney. After the tumor was delivered, it

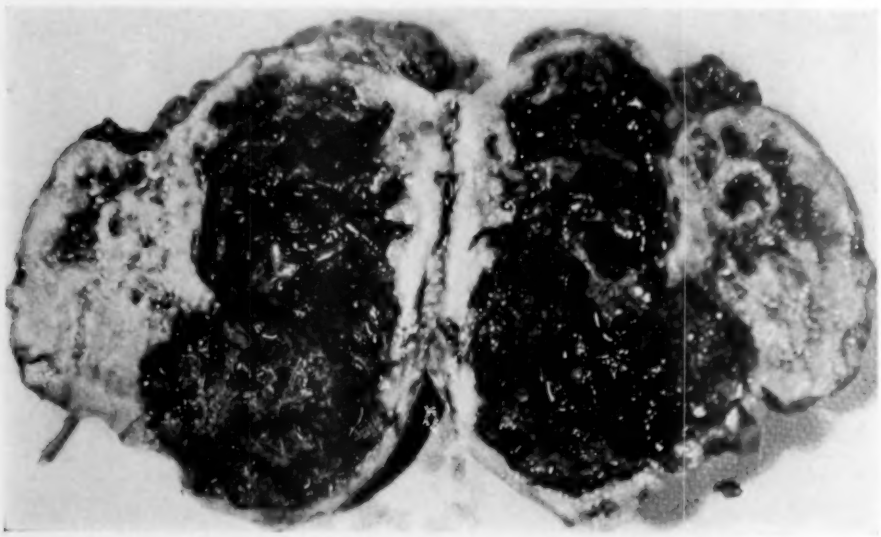

FIG. 3.—Extra-gastric sarcoma showing cystic degeneration.

was seen to spring from the posterior wall of the stomach. The differentiation between the stomach wall and the tumor was clearly marked. The tumor with the involved portion of the stomach wall was resected and the stomach closed. The patient was shocked following operation, and an immediate transfusion of 500 cubic centimetres of whole blood was given.

The growth was an irregular lobulated tumor mass, twenty by thirty by fourteen centimetres, weighing 1,280 grams. A portion of the omentum was attached to the mass. A small portion of the stomach formed a part of the mass. There is an ulceration of the stomach. A large part of the tumor has undergone hæmorrhagic cystic degeneration. (Fig. 3.) *Microscopical Diagnosis.*—Spindle-cell sarcoma. After a stormy convalescence, which was complicated by a pneumonia of the left lower lobe, the patient made a complete recovery.

CONCLUSIONS.—(1) Sarcoma constitutes between 1 and 2 per cent. of all gastric tumors.

(2) They present a higher percentage of operability than carcinoma of the stomach.

(3) As the tumor is usually sharply demarkated from the normal stomach, a resection of the tumor can frequently be made and the stomach sutured in continuity. Needlessly dangerous radical resections can thus be avoided.

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PARTIAL HYSTERECTOMY AND THE USE OF THE STUMP OF THE UTERUS TO SUPPORT THE BLADDER IN THE VAGINAL OPERATION FOR PROLAPSE

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of Richmond, Virginia

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The many operations which have been advised for prolapse of the uterus and bladder may be classified into two major groups: (1) Those performed from above through the abdomen, (2) those performed from below through the vagina. In many cases, operation through both routes of approach is called for. Decision as to which route to employ will be influenced largely by the extent of the cystocele. A moderate protrusion of the bladder may be corrected by suspension of the uterus from the abdominal side as a supplementary procedure after repair of the perineum. In those cases in which the cure of the cystocele is the major problem, the desired purpose is usually best accomplished by an operation through the vagina.

The several commonly employed operations designed for this purpose are intended to give support to the bladder, by interposition of the uterus or broad ligament into the area located between the bladder and the vault of the vagina.

That the operation should be made to fit the patient rather than the patient made to fit the operation is obviously indisputable. The use of a rational procedure which, with material at hand, can be fitted successfully to a great majority if not all cases is highly desirable.

For the cure of cystocele, it is quite indisputable that the best results will be secured by employing for support of the prolapsed bladder an adequate amount of uterus or the broad ligaments pulled down from their position within the peritoneal cavity and sutured firmly into a new position beneath the bladder to whatever fascia may be present in the vault of the vagina.

As a matter of fact, the problems of plastic surgery are not wholly unlike those of altering clothes until a proper fit is secured. The operation for cystocele is largely a job of ladies' tailoring, not so much for looks as for the relief of distressing symptoms.

The use of the entire uterus, according to the method usually designated as the Watkins operation, finds wide acceptance, and is satisfactory in many cases.

There are, however, certain cases in which the uterus is so large that after interposition according to the Watkins method there will be found a bulging tumor at the site of the former cystocele, which is unsatisfactory even to a widow, and may come down broadside into the vagina.

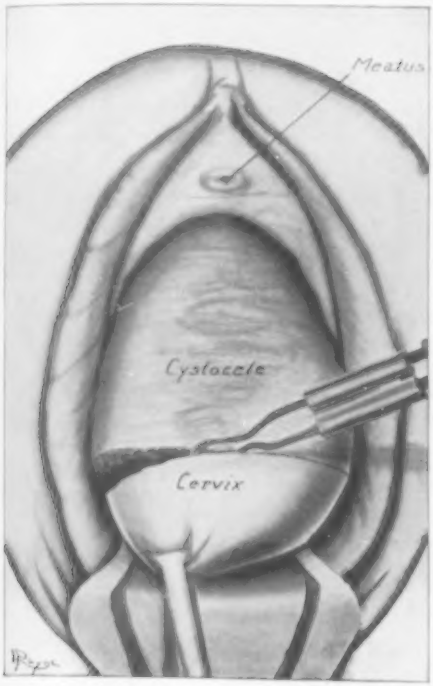

FIG. 1.—Cervix pulled down and being amputated with cautery knife.

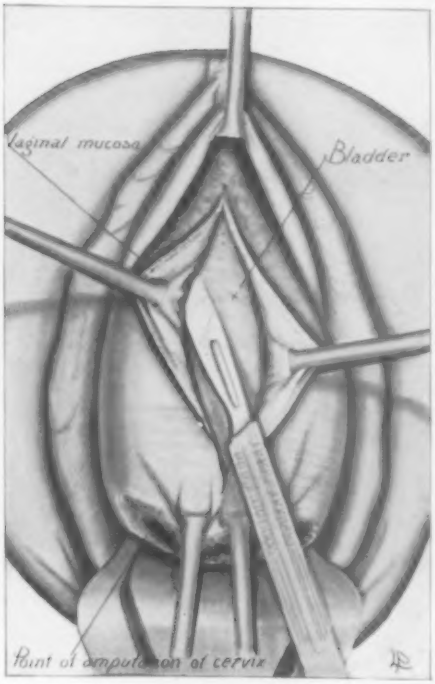

FIG. 2.—The vaginal mucosa being dissected off, exposing the bladder.

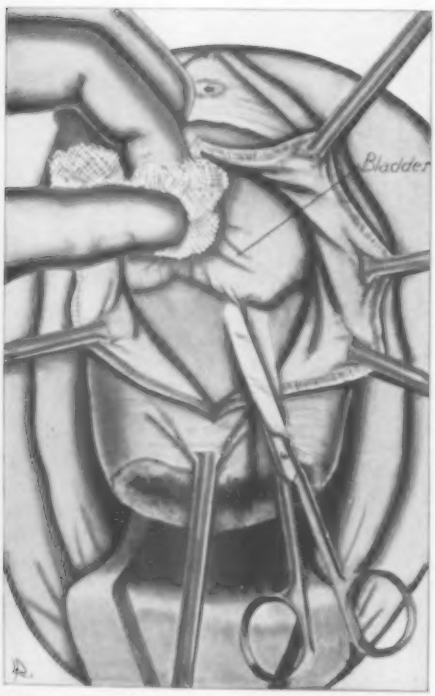

FIG. 3.—Bladder being brushed up and dissected until the peritoneum comes into view.

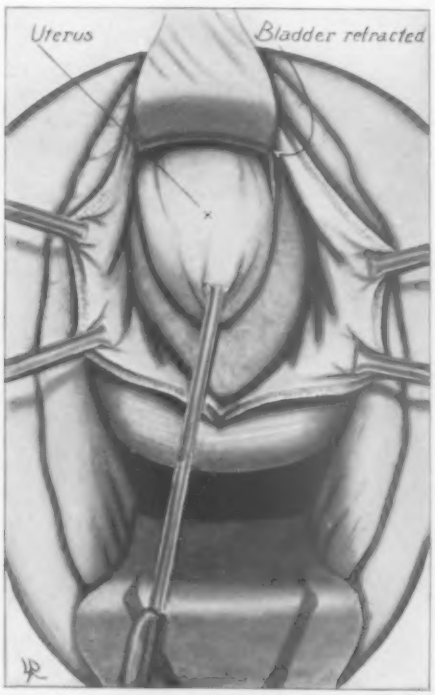

FIG. 4.—The peritoneum has been opened, the fundus of the uterus pulled out of the peritoneal cavity.

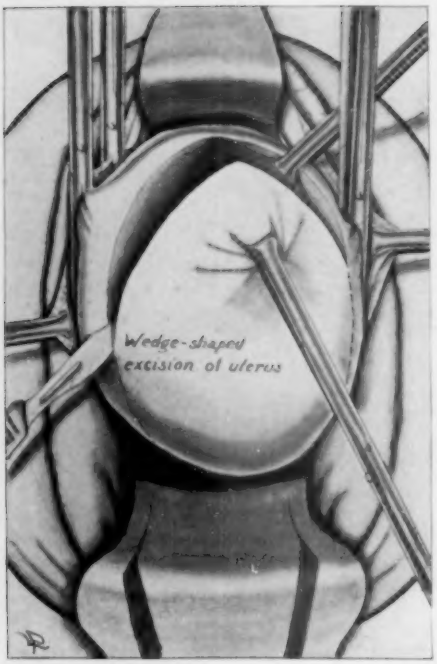

FIG. 5.—A large wedge-shaped piece of the uterus being excised, including the whole fundus, down to the internal os.

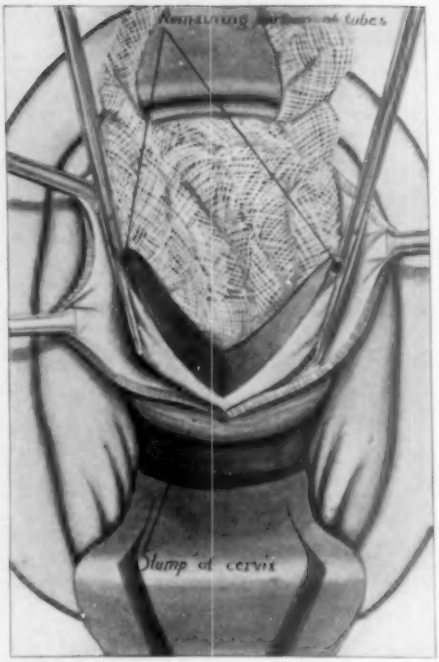

FIG. 6.—A small piece of the lateral walls of the uterus left after excision of the fundus.

FIG. 7.—The whole anterior wall of the uterus, including the cervix and the interstitial part of the tube, is excised according to the method of Masson. This picture is redrawn from Masson's article in Minnesota Medicine, February, 1929.

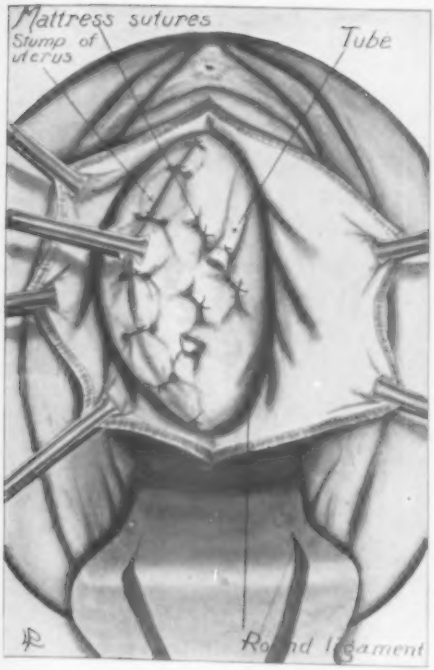

FIG. 8.

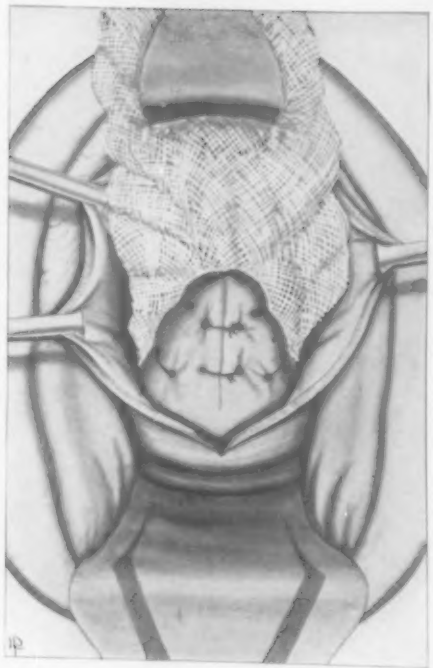

FIG. 9.

FIG. 8.—The sides of the uterus and ligaments sutured together after excision of the wedge-shaped portion of the fundus. In this case the uterine ends of the tubes are allowed to remain, and the division of the tubes between ligatures is shown.

FIG. 9.—A small stump of the cervix sutured together after removal of nearly all the uterus.

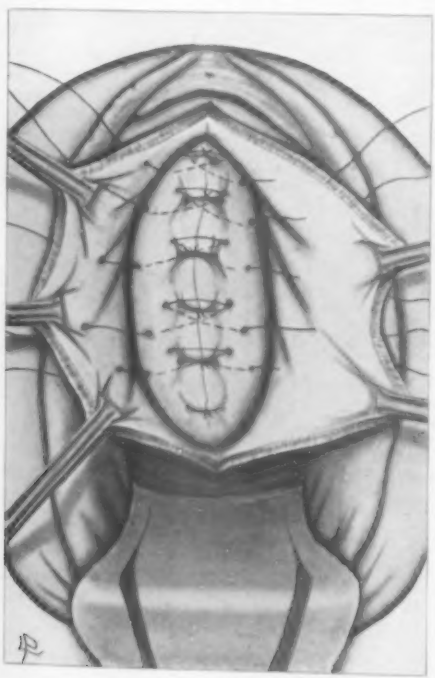

FIG. 10.

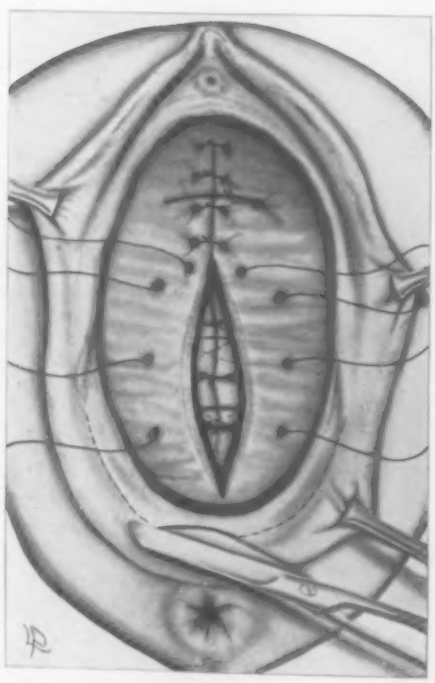

FIG. 11.

FIG. 10.—The stump of the uterus interposed under the bladder is being sutured to the vaginal mucosa. Note the figure-eight hæmostatic sutures in the uterus.

FIG. 11.—Edges of the vaginal mucosa being sutured, and perineorrhaphy being started.

For extensive prolapse in old women with small uterus and long ligaments, the removal of the cervix and the overlapping of the broad ligaments serve to give support, as is shown by the extreme popularity of the Mayo operation. To remove the cervix, however, always entails a certain risk, such as accidental opening of the rectum and injury to the ureters, and though these dangers and hæmorrhage may be avoided by painstaking care on the part of skillful surgeons, accidents will occasionally happen, especially in the hands of less skillful operators.

Moreover, there are cases in which, after removal of the uterus, the broad ligaments, if sutured together, according to the method of Mayo, will be found to be under considerable tension and liable to pull apart, permitting recurrence of a much larger cystocele. For this situation, with the cervix

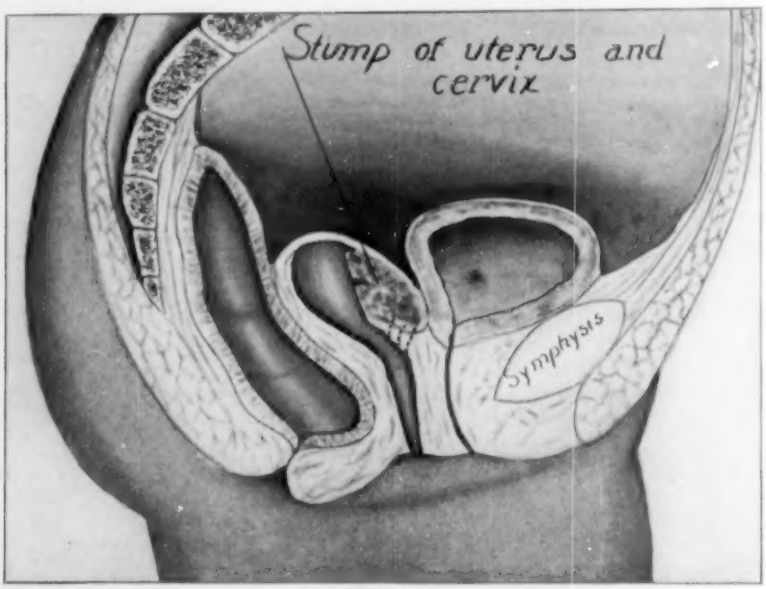

FIG. 12.—Diagram of the sagittal section showing position of the bladder and the stump of the uterus at the completion of the operation.

and its supports gone, the recurrent cystocele, if curable at all, may call for the ingenious and tedious abdominal operation devised by Robert Payne.[3]

About a year ago, when about to operate upon a case of extensive cystocele and uterine prolapse in a fat woman fifty-one years old, it was found that to have sutured the entire uterus in place by the Watkins method would have left an undesirable tumor in this location; and to have removed the uterus would have been unwise because of the fact that the broad ligaments might have been too short to have permitted their suture according to the proper Mayo procedure.

To solve the problem, after delivering the fundus of the uterus in the usual manner, it was seen that the uterus could be reduced very considerably in size by excising a wedge-shaped piece, involving the whole fundus, and about half the width of the body of the uterus down to the level of the

internal os. This was done. The sides of the remaining piece of uterus sewn together made a nice fit and left a sufficient amount of tissue to bring up into position underneath the bladder, and made a very satisfactory foundation upon which the bladder could rest, leaving no bulge in the vault of the vulva.

I have performed this operation in women ranging in age from thirty-six to sixty-five years, and in varying degrees of prolapse. The appearance at the conclusion of the operation and nearly a year later is so satisfactory that I venture to report the procedure as a useful one for the cure of nearly if not all cases of cystocele.

I have not found the procedure described. It is mentioned by H. J. Boldt in discussing Mayo's operation before the Southern Surgical Association, in 1914.[1] I have learned through correspondence with J. C. Masson that he has removed the anterior portion of the uterus, including the cervix, in selected cases.[2]

It is comforting to know that the idea has been tested by good surgeons.

The operative procedure is as follows:

The cervix is pulled down in the usual way, and amputated nearly up to the internal os with an electric cautery knife. (Fig. 1.)

With a tenaculum holding the cervix steady, the vaginal mucosa is divided from a point three-fourths inch behind the meatus, almost to the point of cautery amputation. The vaginal mucosa is dissected off around to the side, giving good exposure of the bladder. (Fig. 2.)

The bladder is pushed up by a gauze-covered finger and with the aid of scissors, and pushed upward until the peritoneum comes into view. (Fig. 3.)

The peritoneum is divided in the usual way and the fundus caught either with the finger or tenaculum, and pulled into the vagina as traction is released from the cervix. (Fig. 4.)

A large or small piece of the uterus is excised, including the fundus, and all the endometrium, leaving only enough uterine wall to bring together by suture, and place under the bladder for support. (Figs. 5 and 6.)

The edges of the uterus are held in neat apposition with mattress sutures. (Figs. 8 and 9.)

The stump of the small piece of remaining uterus is now interposed between the bladder and the vagina. For this purpose the figure-eight stitch for placing sutures in the uterus, as suggested by Cullen, prevents bleeding and subsequent accumulation of blood in the space after operation. (Fig. 10.)

Finally, the edges of the incision in the vagina are brought together by interrupted sutures. Perineorrhaphy is then performed. (Figs. 11 and 12.)

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PILONIDAL SINUS

By Mandel Weinstein, M.D.
of Long Island City, New York

In reviewing the subject of pilonidal sinus (sacro-coccygeal; dermoid; pilonidal cyst) the reader wonders at the lack of scientific consideration accorded a condition not infrequent in hospital practice. In 1867, J. M. Warren,[13] who was the first to record this lesion, remarked that nowhere had he seen mention made of it. He noted the tendency to confusion with fistula-in-ano, and advised complete removal. However, in 1880, Hodges[8] offered the name "pilonidal cyst"—from "pilus" meaning hair, and "nidus" meaning nest.

The lesion can be described, in its uncomplicated form, as a small opening in the skin, three or four millimetres in diameter, at the level of the sacro-coccygeal joint, and usually in or near the posterior mid-line of the body.[12] The orifice is round or oval, edges smooth, covered by skin, and free from granulation tissue. Occasionally, one will notice a small tuft of hair projecting through the opening. A probe[10] passed into the sinus tract is directed upward, a method of differentiation from fistula-in-ano, the sinus of which points toward the anal ring.

If pyogenic infection is present, physical examination discloses a red swelling, with or without fluctuation, and a sinus usually above the anus, rarely a little to one side. Below the swelling and between it and the anus may be observed one or more post-anal or coccygeal dimples always in the mid-line.[9] The cysts may suppurate and be mistaken at first for ischio-rectal abscesses or fistulæ, the true nature of the condition being discovered only at operation.

Pathology.—Histologically, the tract is lined with epithelium. Often a small switch of hair is found lying loose in the sinus.[6] Unless suppuration has destroyed the walls of the sinus, the tract is lined by skin. The sinus ends blindly in a sacculated pouch, and does not communicate with any other structure.

The surface is lined by stratified squamous epithelium with deep ingrowths, papillary in shape, but well confined by a basement membrane. The supporting tissue is widely infiltrated by inflammatory cells, polymorphonuclear, lymphocytic and monocytic. Focal necrotic areas containing giant phagocytic cells with ingested débris are scattered through the section.

The dermis includes typical glandular structures and hair follicles. Some of the sweat glands lie in the fat at a distance from the lumen of the sinus. In short, the sinus is a modified invagination of true skin, none of its elements being fully developed. Even the characteristic hair is thin, fine, and scanty in pigment.

Etiology.—The condition, although congenital,[3] first gives trouble in early adult life. Of the thirteen cases herewith reported, the average age incidence was twenty-five years—the youngest being seventeen years old, and the oldest thirty-nine years. Eleven, or 85 per cent., were males, and two, or 15 per cent., females. Hyzer W. Jones stresses trauma as an etiological factor. However, this was noticeably lacking in the present study. No cases of pilonidal sinus were ever noticed in the Negro race. Lawson Tait regarded the dimples as defects due to the evolutionary disappearance of a caudal

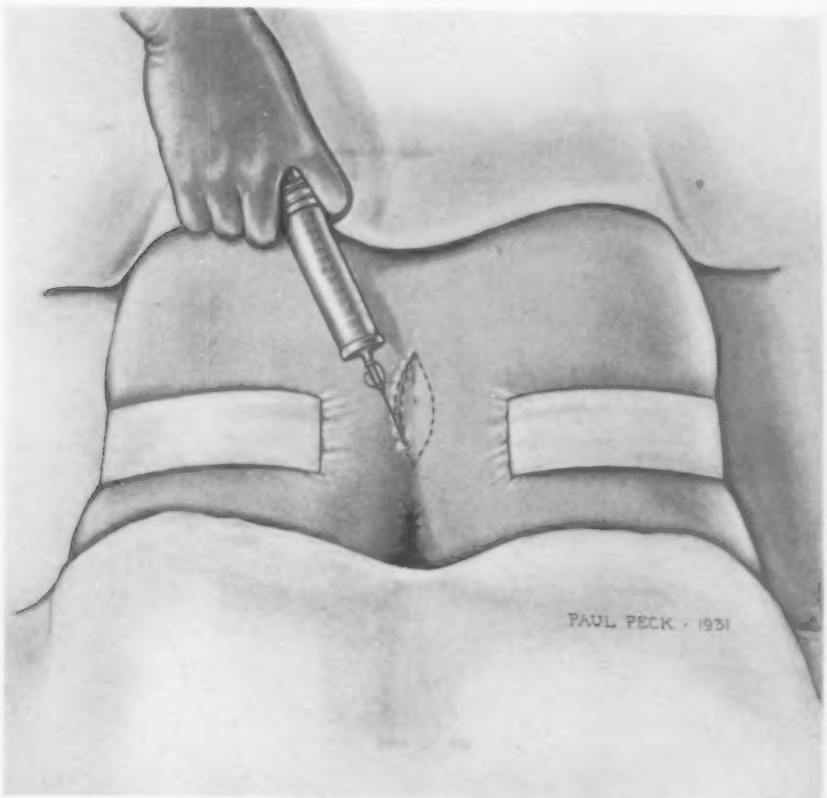

FIG. 1.—Elliptical infiltration of sinus area, including scars of previous operations. Adhesive strips aid the exposure.

appendage. The most plausible modern embryological theory regards pilonidal sinus as a special local downgrowth of epithelium, originating from the true skin, and not the medullary groove.

Treatment.—A number of these patients have had previous operations, the operation consisting of incision and drainage for suppuration along the pilonidal sinus. The greatest number of incisions according to Hayter[7] was eighteen.

Brams[4] injected lipiodol, and Crookall[5] silver nitrate, endeavoring to obliterate the sinus by non-operative measures. Morter[11] emphasizes the use

of Carrel-Dakin solution post-operatively in order to prevent recurrence, but its value is questionable.

The following is a method for radical excision of the sinus which is simple to perform, and thus far has obviated recurrences.

Operation.—The patient lies face downward on the table, with a pillow under the pelvis to elevate the buttocks. Obliteration of the natal cleft and flattening out of this region is accomplished by adhesive plaster,[2] thus eliminating an assistant. Strips three inches wide spread the buttocks apart when attached to the inside of each buttock and fastened just anterior to the anterior superior spine of the ilium. Picric acid 5 per cent. in alcohol is used to prepare the skin. At the same time the solution is generously applied to the adhesive strips, thus sterilizing the entire field of operation.

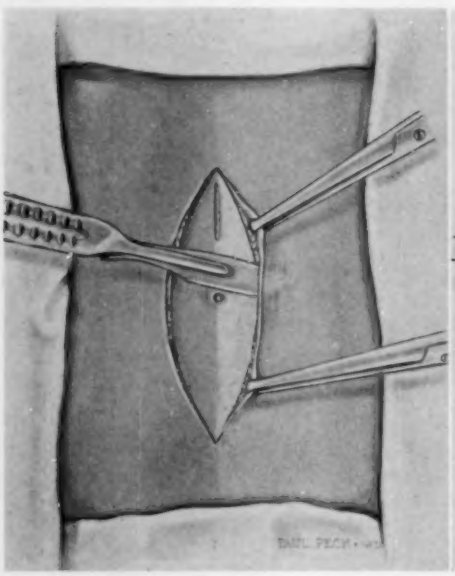

FIG. 2.

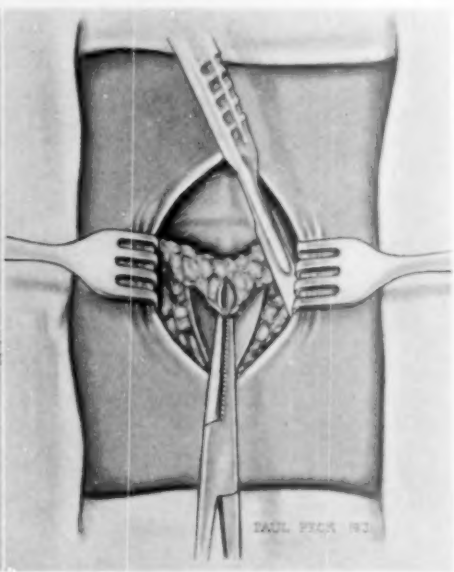

FIG. 3.

FIG. 2.—After incising the skin, the scalpel undermines the tissues for three-quarters of an inch.
FIG. 3.—The scalpel continues to incise in an oblique direction, and strips the tissue *en masse* from the sacrum and coccyx.

Local infiltration anæsthesia, 1 per cent. novocaine with adrenalin chloride, induces anæsthesia. The ischæmic field produced permits easy recognition of the outermost regions of the lesion. Injection of the sinus with methylene blue is ineffective, inasmuch as not all the ramifications of the lesion are penetrated by the fluid. An elliptical incision is carried well beyond the sinus opening and all scars of previous operations, extending through the skin and into the subcutaneous adipose tissue.

The scalpel is then tilted at an angle to undermine skin and a thin layer of fat, for a distance of one-half to three-quarters of an inch. Further dissection is maintained in an oblique plane so that the base of the excised tissue is much larger than the superficial skin-covered portion. In the deep

aspect of the wound, the dissected mass is stripped from the periosteum of the sacrum and coccyx in the mid-line, and on the sides from the gluteal fascia covering the gluteal muscles. In fact, the sinus tissue was so adherent to the periosteum of the sacro-coccygeal region in several cases that only by excising periosteum itself could complete removal of sinus wall be assured. Thorough, wide excision, easily visualized with firm retraction and careful sponging of the wound, is the only safeguard against recurrence. Not more than one or two bleeding vessels require ligation. Four or five tension sutures of the Stewart type coapt the skin, and grasp a portion of underlying subcutaneous tissue. Lack of skin sutures, as suggested by Babcock, prevents early healing and leaves a painful cicatrized mass at the bottom of the spine.[1] A small cigarette drain is placed in the lower-most angle. No

FIG. 4.

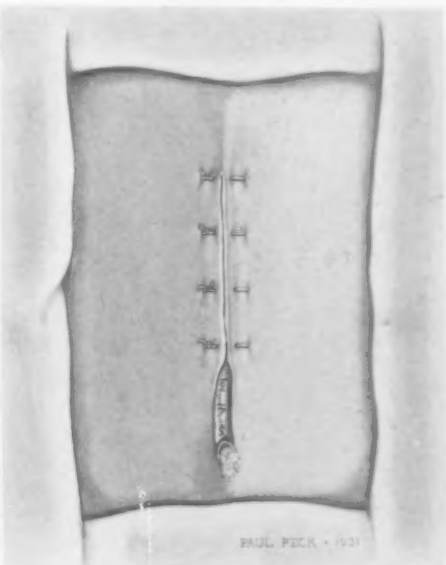

FIG. 5.

FIG. 4.—Cross-section showing contour of excised tissue, and section through lesion. Note tuft of hair and fibrous strands which are in close relationship with sacrum and coccyx.
FIG. 5.—Wound edges coapted with interrupted sutures. Calibrated drain through lower angle.

attempt is made to approximate subcutaneous tissue, gluteal fascia or muscles, as individual layers.

CONCLUSIONS.—(1) Pilonidal sinus is more common than one would suppose from a survey of the literature. The conclusions and suggestions for permanent removal as evolved in this study are based on thirteen cases operated upon by the author.

(2) The differentiation of pilonidal sinus from fistula-in-ano is readily made by the absence of granulation tissue, and the upward direction upon probing.

(3) Pilonidal sinus is a special local downgrowth of epithelium, originating from the true skin.

(4) A large section of tissue with a broad base and narrower superficial skin surface will help to prevent recurrence. If necessary, periosteum of sacrum and coccyx, and gluteal fascia are removed when involved.

(5) No attempt should be made to completely eliminate dead space—this is impossible.

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SYPHILITIC LEG ULCERS

CLINICAL FEATURES PRESENTED BY 100 CASES

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The clinical material upon which this study is based consists of 100 clinical cases seen by the author in a colored male surgical clinic of the Charity Hospital of New Orleans between September 15, 1930, and July 1, 1931. The clinic is a general surgical clinic and serves patients from five years of age upward.

The basis on which the ulcers were diagnosed as luetic was purely clinical, and lest this statement be considered to discount the subsequent discussion and conclusions in the estimation of the reader, an attempt should be made to justify the basis of selection before proceeding farther. It might be argued that leg ulcers cannot, or should not, be diagnosed as syphilitic unless the patient can be shown to present a definitely positive serological reaction for syphilis. It is partly this idea, partly an error in logic which leads White[1] to what I believe an unwarranted conclusion. Arguing from the premises (1) that syphilis is said to be from three to eight times more common in men than in women and (2) that ulcers of the leg are four times more frequent in the female than in the male, White concludes that "syphilis is not the strong determining influence it is supposed to be" in the production of leg ulcers. This rather prevalent idea also leads Eloesser[2] to the conclusion that "true gummas of the legs are rare in comparison to the frequency of ordinary leg ulcers," for he finds that in a series of seventy-six leg ulcers of various types seen at the San Francisco Hospital, the Wassermann reaction was positive in only eleven cases.

Naturally, the percentage incidence of syphilis varies greatly in different parts of the country and in different social strata in any given part of the country, and, for that reason, the relative number of cases of any manifestation of syphilis seen in any given community or by any given individual may be small or great depending upon his geographical location and the class of patients he treats. In the particular clinic from which these cases were taken, the serological incidence of the disease is unusually high, as shown in a previous communication,[3] at least 35.5 per cent. Accordingly, if one were to use the Wassermann reaction or any other serological reaction for syphilis as the most important consideration in differential diagnosis in this particular clinic, the conclusion would be inevitable that more than one-third of all lesions, not only ulcers of the leg, but bone felons and bunions, are syphilitic. In other words, it should be clearly appreciated that the fact that a patient is syphilitic as shown by a serological reaction is by no means an infallible indi-

cation that any given lesion from which he may be suffering is syphilitic, whether that lesion be an ulcer of the stomach or an ulcer of the leg.

To return to the principal line of thought, had I collected the present series of cases on the basis of serological reaction rather than clinical manifestations, I should have laid myself liable to the mistake of including on the one hand certain ulcers, arteriosclerotic, mycotic, varicose or otherwise, which happened more or less fortuitously to occur in syphilitic patients, and of excluding, on the other hand, certain ulcers which presented all the clinical manifestations of a syphilitic lesion, except the serological reaction. As a matter of fact, I am convinced as a result of a rather extensive experience with syphilitic patients in a large charity hospital that in this locality at least, of all syphilitic lesions, the leg ulcer is perhaps less likely than any other to be associated with a positive serological reaction. A history of previous genital ulceration of several weeks' duration, previous antisyphilitic treatment in a reputable institution, or a childless marriage of several years' duration is, I am fully convinced, of much greater diagnostic significance. This is probably due in part to the fact that the syphilitic leg ulcer is an extremely late manifestation of the disease and that the age period at which it characteristically occurs is relatively far advanced—facts which will soon be substantiated by statistical evidence.

The value of underlying osseous and especially periosteal changes in the diagnosis of luetic ulcers of the leg is a debatable question. I had originally intended to cause to be taken and to examine skiagrams of the legs of all the cases in the present series with the idea of establishing the diagnostic value of the association between luetic periostitis and luetic ulcer. I had not proceeded very far, however, before it became apparent, on the one hand, that many ulcers both clinically and serologically luetic showed no such osseous and periosteal changes, whereas, on the other hand, the changes under discussion were very apparent in connection with many ulcers which had existed for long periods of time and which were very obviously not syphilitic.

Certainly clinical evidences of tibial periostitis do not occur in all cases of lues. In a recent careful survey* of 304 cases from the same clinic from which this study is taken, there were seen only twenty-two cases of clinical tibial periostitis.

Skiagrams are much more reliable for the purpose of showing bone changes than clinical methods, but Stokes[4] states that the outright X-ray diagnosis of syphilis is possible in only forty-eight per cent. of cases and I am sure that such a figure is not too conservative. More will be said about the osseous changes associated with leg ulcers subsequently, but the consideration of interest at present is that the diagnosis of syphilitic ulcer of the leg cannot be made or refuted solely on the basis of associated osseous and periosteal changes. Because I became thoroughly convinced of this fact before the investigation had proceeded more than halfway, I did not consider the expense involved in a complete study of routine skiagrams to be warranted, and ac-

* Unpublished.

cordingly, I am unable to report a complete series of correlations between the X-ray appearance of the underlying bones and the occurrence of syphilitic ulceration of the overlying soft parts.

Perhaps the present study could have been made more valuable had the procedure of biopsy been adopted routinely. In favorable cases, it is undoubtedly possible to diagnose luetic lesions on the basis of tissue architecture. The technical difficulties involved in such a procedure in any considerable series of cases, such as the present one, are so great, however, that, although the procedure was contemplated, the idea was rather promptly abandoned. In any case, it is questionable whether biopsy would have been diagnostic in a really large percentage of cases, considering the duration of most of the lesions and the concomitant tissue changes introduced by secondary infection. At all events, to my knowledge this procedure never has been adopted on a sufficiently large scale to furnish data on which a satisfactory comparison with such a series as the present one could be based.

Accordingly, the diagnosis of syphilitic ulceration of the lower extremity in the last analysis and in the present stage of development of diagnosis is a matter of clinical manifestations rather than laboratory data. These data are of great value as confirmatory evidence in doubtful cases, but cannot be considered as disproving the diagnosis when they do not confirm it. As a matter of fact, the diagnosis of the particular lesion under discussion is not at all difficult when it is understood that it represents a disintegrated cutaneous or subcutaneous gumma, which becomes an open lesion by a process of necrosis and ulceration. The history of the mode of development of the lesion, together with the appearance of the typical cavity after the ulcerating gumma has become detached, showing as it does its circular or ovoid contour and perpendicular walls, is sufficiently diagnostic in most cases to render the etiology of the lesion relatively certain. Of course, in any case a final conclusion cannot be reached without carefully considering the differential diagnosis, and every effort was made in assembling the present series of cases to avoid including ulcers associated with varicose veins or with marked arterial vascular changes or any ulcers in which the appearance of the lesions suggested that mycotic infection or malignant changes might be present.

Before dismissing this introductory part of the discussion, an especial point should be made of what I consider to be a very valuable, perhaps the most valuable, sign in the differential diagnosis of luetic ulcers, regardless of their location—I refer to the characteristic odor of these lesions. Certainly this odor previously has not received the attention to which it is entitled. Indeed, the only unmistakable references to it which I can find in the literature are those by Broeman,[5] who states that from the ulcer "a yellow serosanguinous fluid exudes, which has an almost unbearable odor," and by Ochsner and Garside,[6] whose attention was directed to the odor by experience in the same clinic from which the present series of cases was collected. Dr. I. M. Gage first called my attention to the peculiar stench of these lesions, and my subsequent experience leads me very firmly to the belief that it is not

only invariably present in the early stages of the luetic ulcer wherever situated but that it is a peculiar odor not associated with any other lesion. I have often attempted to frame some sort of description of the odor in words, but the result has been far from satisfactory. The odor is exceedingly foul, so much so that it can often be detected as a patient enters the room and before the lesion has been exposed—a veritable stench which may or may not be strong but is exceedingly pervasive; it presents some of the characteristics, especially the sourness, of the foulest of old cheese, but it is nauseating like the odor of moist gangrene. I am willing to hazard a guess that the odor results from certain volatile fatty acids derived from the disintegration of the subcutaneous fat of the patient. I have been especially observant of this odor in the assembly of the present series of cases.

Pathology.—The syphilitic leg ulcer represents a broken-down cutaneous or subcutaneous gumma, very rarely a gumma of periosteum or even bone. The gumma, of course, is a typical granuloma and shows the characteristic histopathological picture of such lesions. It consists of granulation tissue, shows perivascular infiltrations of lymphocytes and plasma cells, and usually contains a few giant cells. The regional blood-vessels show hyperplastic or obliterative endarteritis, and because of these vascular changes, the gumma, sometimes early, but especially in its later stages, shows mucoid degeneration and central caseation necrosis. The gumma proper is surrounded by fibro-connective tissue in which there are usually to be seen imperfect new blood-vessels.

Microscopically, an early gummatous lesion is a solid, either firm or soft, generally rounded mass which, on cross-section, is yellowish or grayish in color. When interference with its blood supply occurs, it rapidly undergoes central caseation necrosis, and when incised or when it ulcerates spontaneously, it discharges a characteristic thick, yellowish, usually sterile, necrotic material. Frequently the contents of the lesion are not completely necrotic at the time of evacuation, and in such cases, a softened core of yellow tissue remains behind for a few days, but its attachments soon become liquefied and the mass then usually comes away *en masse*, leaving a clean-cut cavity lined by a thickened membrane or cortex, the surface of which tends to be regularly rounded and smooth. The ulcer or cavity left by the lesion may be shallow, but is frequently deep, the floor in the latter case sometimes consisting of the external surface of the subjacent muscular plane. In such cases, the floor is frequently as clean as if a careful artificial dissection of the muscles had been performed.

Clinically, a cutaneous or subcutaneous gumma is a painless lesion unless it has undergone secondary infection with the ordinary pyogenic bacteria, in which case it can only with difficulty be differentiated from those abscesses representing infected hematomas. In the case of gumma with secondary infection, the differential diagnosis from infected hematoma is especially difficult because in most cases both lesions present a history of previous trauma.

Cutaneous and subcutaneous gummas may occur on any part of the body.

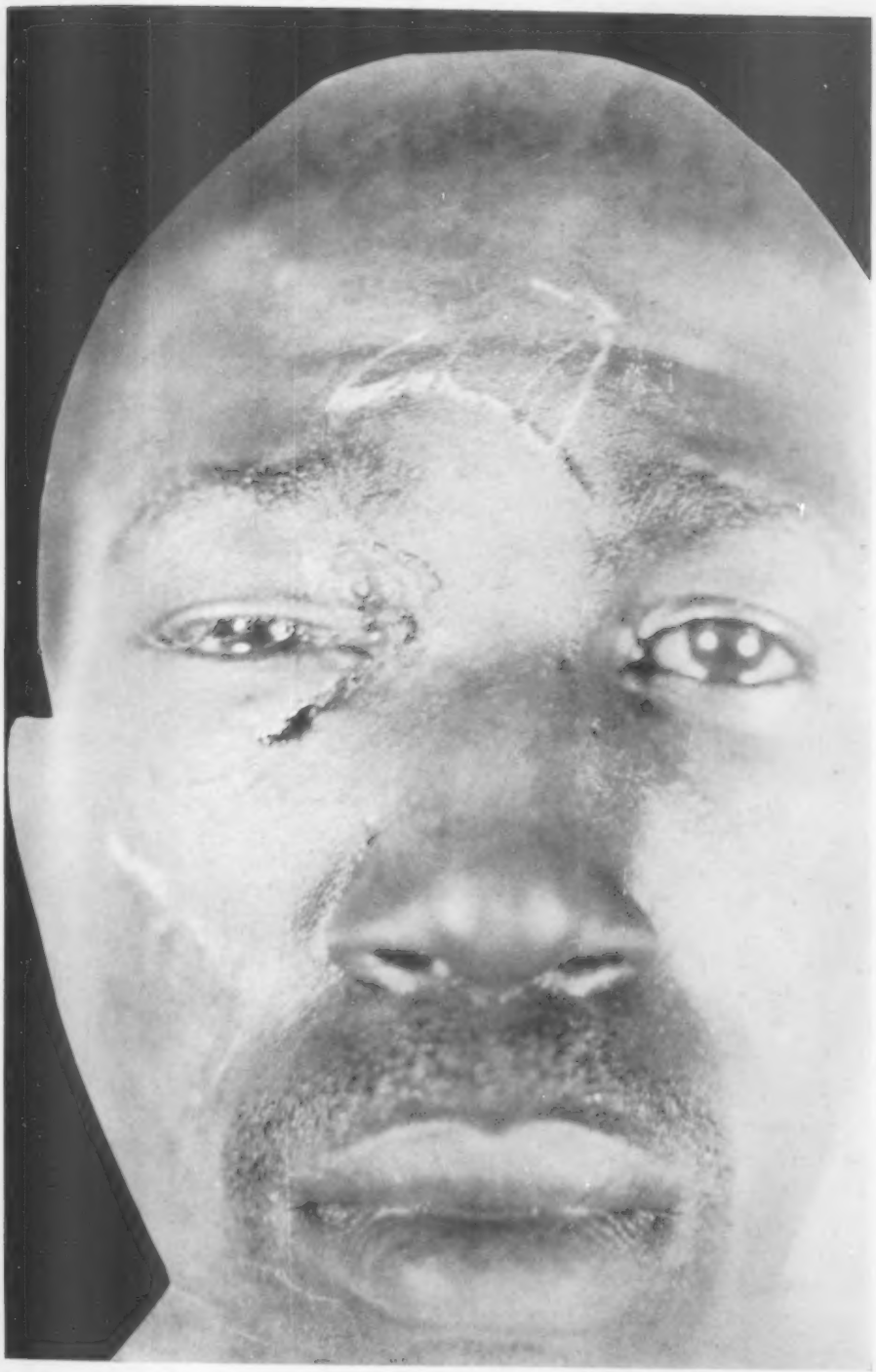

FIG. 1.—L. S., aged twenty-four years. Cutaneous gumma inner cantus right eye. Duration—two weeks. Wassermann—strongly positive. Ulcer healed under active antiluetic therapy in four weeks.

I have seen them on the face, neck, breast, abdomen, arms, hands, legs and feet. The accompanying photograph of such a lesion near the inner canthus of the eye is an example of a rare location. (Fig. 1.) Incidentally, it so happens that I have under observation and treatment at the present time three cases in which the lesion occurred on the same portion of the upper extremity: *viz.,* just above the left elbow on the inner surface of the arm. Two of these lesions I have been able to observe throughout virtually their entire development. I first saw them as small, firm, non-tender nodules freely movable beneath the skin. They gradually increased in size, the skin over the surface of each gradually became somewhat reddened, but still not acutely tender or painful, and they ultimately broke through the skin. The

FIG. 2.

FIG. 3.

FIG. 2.—H. S., aged thirty-six years. Subcutaneous gumma left arm, inner aspect, just above elbow. Began as slightly painful swelling four days ago: progressive enlargement under home treatment to "bring it to a head." Penile ulcer, presumably chancre, two years ago. Wassermann—strongly positive. Note necrotic gumma still *in situ* and compare with Fig. 3.

FIG. 3.—Same patient as Fig. 2, two days later. Attachments of gumma have become liquefied and entire gumma has been lifted out with forceps. Base consists of superficial surface of muscular plane. Lesion healed completely in three weeks under antiluetic therapy.

accompanying photographs show two stages in the development of one of these lesions after ulceration had occurred. In the first (Fig. 2) the gumma is still *in situ,* attached loosely to the base of the ulcer, soft, yellow and friable. The latter photograph (Fig. 3) was taken *three* days later and shows how cleanly the necrotic gumma came away, leaving the underlying muscles completely exposed.

As a rule, cutaneous gummata heal rather rapidly under the influence of anti-syphilitic treatment. When actively treated, it is distinctly unusual for the lesion to remain open for more than two or three weeks, the time interval depending in large part upon the extent of the lesion, particularly the surface

area destroyed. The arsenobenzols and mercury sometimes serve to effect a cure in the absence of iodide medication, although the iodides are, of course, indicated in most cases, and I have seen these lesions heal on what is colloquially known as "mixed treatment"; *viz.*, a prescription for oral administration containing mercury in the form of bichloride and iodine in the form of potassium iodide—a form of treatment which, to say the least, is not very efficacious.

Peculiarly, cutaneous gummas, when they occur below the knee and break down to form luetic ulcers, frequently do not behave like similar lesions elsewhere but show a remarkable tendency to become chronic. Not all such ulcers behave thus, for not infrequently patients under treatment for chronic syphilitic leg ulcers give a history of the occurrence of previous similar lesions situated either at the same site or in an adjacent locality which apparently presented the same type of onset and clinical characteristics but healed under the influence of simple home remedies or simple local applications prescribed by druggist or doctor.

The reason for the general chronicity of syphilitic leg ulcers is not readily apparent, but considering the fact that syphilis shows an especial predilection for the blood-vessels, and that syphilitic leg ulcers usually occur in persons of middle age or older, it seems highly probable that the chronicity of these lesions is dependent upon precisely the same factors which produce chronicity in varicose, tuberculous, and callous leg ulcers—factors which are not dependent upon the immediate cause of the lesion but are more or less fortuitous and have to do with the anatomical and pathological peculiarities of the lower extremities. These peculiarities have been discussed so often in connection with the so-called callous ulcer that they need not here be considered at length. The formula (1) weakened veins, (2) scanty musculature, and (3) poor blood supply, was so familiar to Coues,[7] even in 1912, that he had grown tired of it. Likely enough, these three factors do not explain the matter satisfactorily, but I have no better to offer.

However, of this I am sure, that legs afflicted with chronic luetic leg ulcers frequently show tissue changes apart from the ulceration itself, which can best be explained on the basis of underlying vascular disturbances. I refer particularly to pigmentation, various skin rashes, and alopecia on the surface, and periphlebitis, ossification of soft tissues, periostitis, osteitis, and arthritis in the deeper structures. These changes have been noted by Wright[8] and others as more or less characteristic of legs afflicted with chronic leg ulcers of other sorts.

At this point, some further mention should be made of the feasibility of using periostitis of the tibia and fibula as a differential point in the diagnosis of luetic leg ulcers. According to Coues,[7] Post was the first author to point out the predilection of syphilis for producing periostitis of the tibia rather than other bones. At all events, periostitis of the tibia has come to be recognized as one of the well-known diagnostic signs of the disease, and many authorities place great store by it. It would seem reasonable, therefore, that

one of the ways in which to determine whether or not a given ulcer is luetic would be to examine a skiagram of the extremity for evidences of tibial periostitis. Unfortunately, however, there is a difficulty in the way of this simple diagnostic procedure in that it seems to have been demonstrated by many observers that any ulceration of the leg which has persisted long

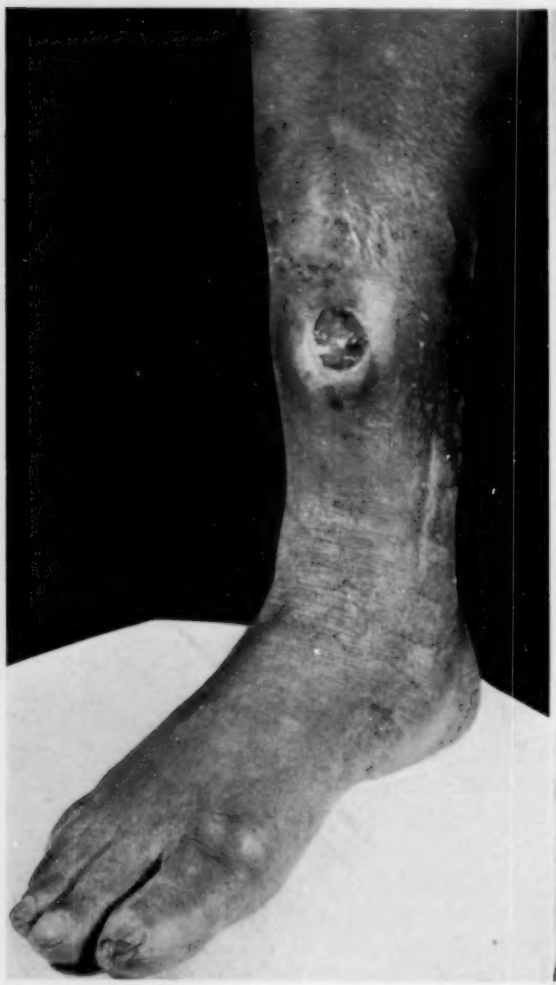

FIG. 4.

FIG. 5.

FIG. 4.—S. T., aged fifty-four years. Cutaneous gumma right leg, anterior aspect, junction middle and lower thirds. Duration—five days; opened with a needle. Note circular contour, perpendicular margin, surrounding œdema due to secondary pyogenic infection. Patient has definite periostitis of both tibias, more noticeable in right tibia. Patient father of six children, only one living. Wassermann —negative. Indefinite history of (possible) primary lesion many years ago.

FIG. 5.—P. G., aged thirty-nine years. Multiple gummas of left leg, anterior aspect, junction middle and lower thirds. Duration of lesions—three months. History of penile ulcer, presumably chancre seventeen years ago. Wassermann—strongly positive. These lesions approach the type usually regarded as classical.

enough is associated with periostitis of the underlying bones, whether the ulcer is luetic or not. This observation has now been made by a sufficient number of observers to establish its truth beyond reasonable doubt.

The earliest description of these changes which I have been able to find and perhaps also one of the most rational and complete is that by Coues,[7] in 1912. He says that "long-continued ulceration of the leg, whether varicose, specific or undetermined, is often accompanied by extensive changes in the long bones, often only demonstrable by radiographs. These changes may be specific or non-specific." Morris[9] described bone changes as well as changes in the blood-vessels and lymphatics in non-syphilitic ulcers. Carp,[10] in 1921, described productive periostitis in connection with non-specific ulcers. He regarded this periostitis as due to a low-grade infection derived from the ulcer. The infection, he thought, might presumably occur either by direct extension of the inflammatory process or by way of the lymphatics, especially those which accompany the blood-vessels which supply the bone. Carp says that if the non-specific infection in any chronic ulcer "has persisted long enough, there is an extensive productive periostitis of either the tibia or the fibula, or perhaps both. If the ulcer is on the tibial side of the leg, low down, it will be noted that the periostitis is perhaps more marked immediately beneath the ulcer, but this is not necessarily true. There may be more evidence of it, röntgenoscopically, at the upper end of the tibia and, strange to say, involvement of the periosteum of the fibula. This productive periostitis at points distant and opposite to the ulcer is quite characteristic." He included reproductions of illustrative skiagrams. Skiagrams of extensive periostitis of the left tibia and fibula associated with osteophytic masses penetrating the interosseous ligament between the two bones are reproduced by Eloesser[2] from the case of a sixty-five-year-old man suffering from an ischemic ulcer, the result of a localized patch of arteriosclerotic gangrene. Coues[7] thought that he could differentiate between cases of syphilitic and non-syphilitic periostitis. In the syphilitic cases, he found that the fibula was as likely, perhaps more likely, to be affected by periostitis as the tibia, and he stated that he accordingly attached great diagnostic significance to "roughening and thickening of any considerable part of the fibula." . . . "Roughness, general thickening, and much increased density of bone through a considerable length of bone are most suggestive of syphilis."

Although it would be very convenient indeed to have some entirely reliable means of differentiating syphilitic from non-syphilitic bone lesions, my own experience indicates that none has yet been devised. Indeed, one of the most harassing problems with which one can be confronted is the röntgenological differentiation between syphilis of bone, the so-called "sclerosing osteomyelitis of Garré," and certain varieties of early bone sarcoma, especially the periosteal sarcoma. I have examined a rather large number of skiagrams of legs in this series of cases with this point in mind, and have come to the following conclusions: (1) Not all leg ulcers which are both clinically and serologically luetic show definite periostitic changes of the underlying bones; (2) when such periosteal changes do occur, the syphilitic cases present an appearance virtually identical with that of the non-syphilitic cases in many instances; (3) when periostitis is demonstrable in legs with recent ulceration,

especially when the periostitis involves both bones of the leg, the presumption is that both processes are luetic. This is especially true if periosteum and underlying cortical reactions blend homogeneously on the skiagram.

Influence of Trauma.—Trauma is generally conceded to be a predisposing cause of luetic as well as other varieties of chronic leg ulcers. This has been mentioned particularly by Coues.[7] In the present series of cases, a history of definite preceding trauma was obtained in 43 per cent. of the cases. The type of trauma varied somewhat but appears usually to have been of more than usual severity. It was occasioned in different cases by a sliver of wood, a dog bite, a train wreck, an automobile wreck, striking the leg with a hatchet, falling against a hot furnace, spilling hot ashes on the legs, and the like. Of course, the legs are portions of the body especially exposed to trauma, and accordingly the rôle of injury as a predisposing factor should not be interpreted too closely. It seems, however, that devitalization of tissue might very likely precipitate gumma formation inasmuch as it would serve as only another example of the appearance of a local manifestation of systemic disease at a "locus minoris resistentiæ."

THE RELATIVE DIAGNOSTIC IMPORTANCE OF A HISTORY OF PREVIOUS ULCERATION ON THE GENITALIA AND THE WASSERMANN REACTION

The statistical survey of the group of cases under discussion indicates that a primary penile ulcer, presumably syphilitic, occurred in 66 per cent. of the cases, only 44 per cent. being negative with respect to a history of a primary penile ulceration. The Wassermann reaction, on the other hand, would seem to be of much less significance; thus the ordinary hospital Wassermann reaction was positive in 37 per cent. of the cases, negative in 63 per cent. There is, of course, a very real danger in interpreting Wassermann-negative reactions too closely in any series of routine hospital cases. This is because there are many modifications of the Wassermann reaction which are in more or less common use in the hospitals throughout the United States, some of which are more sensitive and some less sensitive. When using the more sensitive reactions, scrupulous care must be exercised in the technical performance of the test lest false positive reactions inadvertently be obtained. In order to avoid such false positive reactions when using a sensitive variant, scrupulous care must be taken in the preparation and handling of reagents, and a relatively higher degree of intelligence and skill must be consequently required of the technician responsible for the performance of the test. Unfortunately, in hospital practice the technic of the Wassermann reaction is burdensome, and the source of revenue for the defraying of the expenses incident thereto so inadequate that it is not always possible to employ the most highly specialized technicians for this purpose. Consequently, it is rather customary, especially in the larger institutions, to select some modification of the Wassermann reaction, which is not particularly open to the danger of false positive reactions, and this sacrifice in the delicacy of the test undoubtedly and of necessity interferes with the detection of moderately

weak reactions, which, if detected, might be of clinical significance when scrutinized in the light of clinical findings by an astute and careful practitioner. It is, therefore, quite possible that the incidence of positive Wassermann reactions in such a series as this might be increased somewhat by the employment of a more highly sensitive serological reaction. The author feels sure, however, that not even the most sensitive of such tests would increase the percentage of positive reactions in cases of luetic ulcer by any con-

FIG. 6.

FIG. 7.

FIG. 6.—F. L., aged forty-one years. Cutaneous gumma of the right leg, lower third, anteromedial aspect. Duration of lesion—six weeks. History of penile ulcer, presumably chancre, twenty years ago. Shape irregular in spite of duration, little evidence secondary infection, surrounding skin relatively normal. Wassermann—strongly positive.

FIG. 7.—E. B., aged twenty-seven years. Cutaneous gumma junction middle and lower third right leg, posterior aspect. Duration—six months. Began as a "pimple" which within three days became markedly swollen and reddened and was "opened by a doctor at the hospital with a knife." Active antiluetic therapy has failed to induce healing. Wassermann—weakly positive. Note irregular contour. Absence of reaction in surrounding skin; preservation of relatively typical appearance due to prevention of secondary infection. Regular out-patient care at hospital.

siderable amount, certainly not to such an extent as to make the percentage of positive reactions approach one hundred.

Further evidence in support of the greater reliability of the history over the Wassermann reaction is the fact that of those cases in which there was a disagreement between the history and the Wassermann reaction, those cases presenting a positive Wassermann reaction and a negative history represented

only 38 per cent. of the cases, whereas those cases with a positive history and a negative serological reaction represented 62 per cent. of the cases.

Chronicity.—In only 29 per cent. of the cases had the ulcer been present for one month or less; in 45 per cent. of the cases, two months or less; in 53 per cent. of the cases, three months or less; and in 65 per cent. of the cases, six months or less. Exactly one-quarter of the cases, *i.e.*, 25 per cent., had been present for more than one year; 12 per cent. had been present for more than five years. The duration of the oldest ulcer at the time of coming under observation was twenty-five years. There were five cases in which the duration had been twenty years or more.

In connection with these observations on the duration of the ulcer at the time of its initial observation in the clinic, an attempt was made to determine some correlation between the size of the ulcer and its duration. The surface area of the various ulcers was carefully computed, and the results were tabulated on coördinate paper with these values as ordinates and the duration of the lesion as abscissæ. The result was a typical "scatter" curve in which no correlation whatever could be demonstrated.

Age and Sex Incidence.—There is apparently universal agreement that the luetic ulcer is characteristically a manifestation of so-called "tertiary syphilis," and for this reason, the affection should be virtually a disease of mature individuals, inasmuch as syphilis is, to all intents and purposes, a venereal disease and is consequently contracted as a rule during the period of maximal sexual activity.

Possibly the age incidence in the particular series of cases which are here reported is not exactly representative of a cross-section of the general population, partly because of the sexual precocity of the Negro in general and partly because of the extremely great prevalence of the disease among the Negroes in this locality in particular. On the other hand, as Broeman[5] very properly says: "Luetic ulcers may develop in young persons who are victims of congenital syphilis." Of the frequency with which this actually occurs with respect to ulcers on the leg, I have been unable to convince myself, but I have seen gummas of other parts of the body in presumably "innocent" young boys on numerous occasions, and partly for this reason, I am inclined to regard many cases of leg ulcer in young individuals as probably "innocent," even though the age of the subject is not such as to preclude the possibility of contact infection in the usual manner. In favor of this idea also is the fact that luetic ulcers occur as an extremely late manifestation of the disease; a matter to be discussed in more detail presently.

The average age incidence in the present series of cases was 39.8 years. By decades, the percentage distribution was as follows:

	Per cent.		Per cent.
0–10	0	51–60	13
11–20	7	61–70	6
21–30	21	71–80	4
31–40	23	81–90	1
41–50	25		

The youngest patient in the series was fifteen years of age, the oldest eighty-two years of age.

These figures amply illustrate the fact that the chronic luetic leg ulcer is characteristically a disease of middle life, though it occurs both in youth and in old age. The age incidence of the lesion lends considerable support to the idea that one of the predisposing factors in the development of this form of ulcer is degenerative changes in the peripheral vascular system. Furthermore, although the changes just stated may have something to do with the matter just now to be mentioned, it is interesting to note that, as local manifestations of systemic syphilis go, the leg ulcer shows an unusually long latent period of development; *i.e.*, a long period of time usually elapses between the appearance of the initial lesion and the development of the ulcer. Broeman[5] expressed the matter, though hardly strong enough, when he said that luetic ulcers occasionally develop soon after the development of the primary lesion or in young persons who are victims of congenital syphilis, but more frequently they occur late in the course of the disease. "They usually occur between the third and sixth year of the disease, but may begin at any time after the second year." Ochsner and Garside[6] say that whereas luetic ulcers may occur at any time during the course of the infection (presumably these authors mean during the tertiary stage of the disease), they usually do not occur until two years after the initial lesion. In this series of cases, the average duration of time between the appearance of the initial lesion and the appearance of the ulcer in those cases in which the time interval could be computed with some accuracy was 16.3 years. In no case was the duration of time less than one year, in only 31 per cent. of the cases was there an interval of time of ten years or less, whereas in 69 per cent. of the cases, the latent period was ten years or more.

The universal teaching is that luetic ulcers are more common in the male than in the female, and this is in accord with what might be expected in view of the fact, also universally recognized, that syphilis itself is more frequently encountered in the male than in the female. Unfortunately, inasmuch as the clinical material from which the present series of cases was selected was entirely male, I have nothing new to add on this phase of the subject. White,[1] however, in a series of sixty-nine cases of chronic leg ulcer observed by him over a series of several years, found that of fifty-five cases in females, only five were judged syphilitic, and of fourteen cases seen in males, six were judged syphilitic. This is in accordance with the view shared by many observers that, although leg ulcers in general occur more frequently in the female than in the male, the syphilitic leg ulcer is particularly an affection of males.

It seems to be a common belief that syphilitic ulcers occur most frequently on the upper third of the leg. I have been unable to determine the source of this notion, but I cannot help feeling that it represents tradition rather than accurate observation inasmuch as in those published reports in which statistics can be found, there seems to be little substantiation for the idea,

and in my own experience, as reflected by the present study, it is by no means the case.

Steel[11] states that syphilitic ulcers are most common on the upper, outer half of the leg, but gives no statistics. Also Ochsner and Garside,[6] without quoting statistics, say that "as gummata occur more frequently in the upper

FIG. 8.—F. C., aged twenty-eight years. Cutaneous gumma dorsum foot just above base right fifth toe. Duration—three months. Typical appearance. Note also linear ulceration just above ankle—also cutaneous gumma. Duration—one week. Patient was bitten by "ground rattler" at site of first lesion: as charm against poisoning, has worn tightly tied piece of bright-colored string at place of secondary ulceration. Wassermann—strongly positive.

third of the leg, it is at this site that syphilitic ulcer is most likely to occur." Broeman[5] is a little nearer to what seems to be the truth, still quoting no figures, when he says that all luetic ulcers have a predilection for the region

about the joints, the most frequent site therefore being the knee, but adds that a reasonably large number occur in the region of the ankle—or in another place, "any part of the leg" may be involved, the "calf of the leg usually," though "the region of the knee" is most characteristic.

Goodman,[12] on the other hand, presenting a definite series of sixty-four cases of chronic leg ulcer, apparently all of which occurred on the lower parts of the legs, found thirteen ulcers of the twenty-five which occurred on the right leg to be associated with a positive Wassermann reaction and six (or eight) of the twenty-six ulcers which occurred on the left leg also associated with a positive Wassermann reaction. Wright[8] is alone in stating what I have for some time been convinced is true, that even the definitely specific spirochætal ulcers of syphilis have a proclivity for the same area of the leg as the varicose or "indolent" ulcer.

In the present series of 100 syphilitic ulcers, only one case (1 per cent.) occurred in any part of the upper third of either leg. In tabulating the remaining ninety-nine cases, the legs were arbitrarily divided into middle and lower thirds from above downward and into four segments circumferentially —anterior, posterior, medial, and lateral. In the middle third of the leg occurred 19 per cent. of the cases, in the lower third 71 per cent., and on the foot 9 per cent. The circumferential distribution, considering both legs together and omitting fractions of a per cent., was as follows:

Middle Third Distribution	Per cent.	*Lower Third Distribution*	Per cent.
Anterior	40	Anterior	32
Posterior	10	Posterior	10
Medial	20	Medial	32
Lateral	30	Lateral	26

Goodman,[12] in an effort to discover whether the location of leg ulcers could be made to serve as an important point in the differential diagnosis, collected a series of sixty-four consecutive unselected cases from the surgical out-patient department of Bellevue hospital; apparently he included only ulcers which occurred on the lower parts of the leg. He found twenty-five cases with ulcers of the right leg, twenty-six with ulcers of the left leg, and thirteen with ulcers of both legs. In those cases with ulcerations of the right leg, a positive Wassermann reaction was obtained in thirteen of the twenty-five cases. In those cases with ulcerations of the left leg, a positive Wassermann reaction was obtained in six of the twenty-six cases, but two additional cases presented "slightly" positive reactions. In those cases presenting bilateral ulcerations, only two presented positive Wassermann reactions. Goodman concludes that "ulcers of the right leg are more apt to be syphilitic than those of the left leg, when the ulcers are limited to one leg."

Goodman very properly points out that there seems to be no good *a priori* reason why gummas should show any special predilection for the right leg, whereas there is very good reason why ulcers of the left leg should predominate in any unselected series of cases: *viz.*, the predominance of varicosities,

and hence varicose ulcers, on the left lower extremity. In Goodman's series, syphilitic ulcers were uncountered twice as frequently on the right leg as on the left.

In the present series of cases, there is incomplete confirmation of Goodman's contention and little evidence at all to support the view that syphilitic ulcers are usually or characteristically bilateral. Thus, the right lower extremity was affected in 57 per cent. of this series of cases, and the left lower extremity in 43 per cent. of cases. In two instances bilateral ulcers were seen, but in both of these cases the ulcers were neither bilaterally symmetrical nor comparable in size.

I distinctly remember having seen in my past experience a certain number of cases of bilateral involvement in cases presumably syphilitic, but I feel sure such a condition is the rare exception rather than the rule, as this tabulated series indicates. In extenuation of the notion of bilaterality, it should probably be added, however, that a not infrequent finding is the occurrence of an open syphilitic ulceration on one extremity and a scar of a healed ulcer on the opposite extremity. In such cases, I have been in the habit of assuming that the scar represents a healed lesion of syphilis. This conclusion, however, I have never been able to substantiate by definite evidence. I doubt, in the light of the results in the present series, whether too much emphasis should be placed on the right-sidedness of luetic leg ulcers inasmuch as the preponderance of these ulcers on the right leg was really not very great.

Size and shape.—Probably the commonest teaching with respect to the size and shape of luetic ulcers is that they are small and usually multiple and they tend to show a crescentic shape or arrangement. Thus Strickler[13] states that the syphilitic ulcer presents "an arrangement suggesting a segment of a circle." Ochsner and Garside[6] mention the multiplicity of these lesions and the crescentic appearance. Broeman[5] mentions also their multiplicity, but gives their shape as characteristically round. He says that the typical luetic ulcer consists of "thickly studded patches of ulcers"; the individual lesions vary in size from that of "a pea to that of a hen's egg or larger."

In the present series of cases, 35 per cent. of the lesions were multiple and 65 per cent. single. Of the 35 per cent. which were multiple, 26 per cent. showed two ulcers and 9 per cent. showed three ulcers or more. The average size, according to rough estimations, considering only the largest ulcer in those cases in which the ulcers were multiple, was 5.27 square inches. Twenty-nine per cent. showed a surface area of one square inch or less; 62 per cent., of two square inches or less; 71 per cent., of three square inches or less; 9 per cent., of between five square inches and ten square inches; 11 per cent., of ten square inches or more. Accessory ulcers were much more uniform in size, averaging one-half square inch. In by far the largest percentage of cases the ulcers were round or oval in shape. The remainder were irregular—sometimes very irregular. I can remember having seen very few luetic ulcers which could be properly called crescentic; certainly no instance occurred in this series.

Undoubtedly there is some truth in Ochsner and Garside's[6] contention that the size of luetic ulcers depends upon the amount of secondary infection which has occurred and the duration of that infection. Everyone who has had much contact with these lesions knows that they increase markedly and rapidly in size when neglected. On the other hand, it is equally true that this size may be variable from the outset, depending upon the size of the gumma to which the ulcer is secondary. It has been my good fortune on many occasions to watch the formation of these lesions from the stage of early gumma formation, and it is certainly true that not all gummas on the leg or on any other part of the body are of uniform or even nearly uniform size at the time they liquefy and ulcerate.

Appearance of floor, edge, and surrounding skin.—The floor of the syphilitic leg ulcer in the earliest stages of the lesion is smooth. In those cases in which the gumma from which the ulcer originated was subcutaneous, the floor may consist of the external surface of the underlying muscles and, as previously mentioned, the muscle fibres may be seen as distinctly as if they had been exposed by careful dissection. In those cases in which the gumma was originally cutaneous rather than subcutaneous and in those locations in which the subcutaneous fat is thick, the floor of the ulcer may consist of subcutaneous fat. In this case, the floor is smooth as before but covered by a thick, distinctly yellow, slime which may be torn away in shreds but is extremely tenacious and stringy. As the lesion becomes older, the appearance of the base of the ulcer is apt to become altered by secondary infection or by vigorous or abortive attempts at granulation tissue formation. Unless secondary infection becomes marked, the secretion from the luetic ulcer is apt to be thin, grumous and relatively scant.

The edges of the luetic leg ulcer present a "punched-out" appearance which is very characteristic. The gumma in which the ulcer originates separates from adjacent tissue cleanly, leaving an ulcer wall or edge which is roughly perpendicular to the skin surface.

The skin surrounding a luetic ulcer early presents a relatively unaltered appearance. There may be slight redness in case secondary infection has occurred, but pigmentation, eczema, and excoriation of the surrounding skin do not usually appear except as a result of long-continued irritation by secretions from the lesion.

Treatment.—As probably everyone will agree, the treatment of the chronic syphilitic leg ulcer is partly medical and partly surgical and as in many another therapeutic problem on the boundary line between medicine and surgery, it is difficult to say where the proper usefulness of medicine ends and the advisability of surgical attack begins.

Medical treatment.—All will probably agree on the importance of medical treatment for the systemic disease, even those who feel that the influence of this treatment on the local lesion may not be great. As previously mentioned, my personal experience leads me to the conviction that anti-syphilitic treatment is by no means all that is required in the majority of cases. In

those cases which occur in young individuals, it may be rapidly and completely curative, but in older individuals in whom secondary changes have occurred in the blood-vessels of the extremities, it may induce relatively little healing. Certainly I cannot agree with those who think that vigorous anti-syphilitic treatment is specific, for these lesions and failure of the lesions to heal promptly under such therapy is an adequate reason for questioning the correctness of the diagnosis.

An extended discussion of the principles and practice of anti-syphilitic therapy need not be attempted in this connection. The literature on the subject is stupendous and the opinions of authorities do not coincide in some major and many minor matters. The arsphenamines and mercury have so far commended themselves to the profession as to have virtually come into universal use as anti-syphilitic therapeutic agents. Arsenic has been in more or less constant use in the treatment of syphilis from the time of Fallopius (1523-1562), first in the form of ordinary white arsenic (arsenious acid), then as Fowler's or Donovan's solution, still later as atoxyl (sodium para-aminophenylarsenate), and since 1910, as salvarsan and neosalvarsan (the arsenobenzols).

With respect to the relative efficiency of salvarsan and neosalvarsan, my experience leads me to believe with Burke[14] and others that there can be no question but that salvarsan is a more powerful spirocheticide than neosalvarsan. This fact was impressed upon me originally while a surgeon in the United States Navy. On shipboard, neosalvarsan was the only preparation available; at shore stations salvarsan alone was used; the superiority of the treatment ashore was beyond question. The same fact has been illustrated more recently in a serological study* in which the Kahn precipitation reaction was performed on a rather large series of unselected cases for purposes of statistical survey. Those cases in the group which were not under active treatment at the time but had previously been treated with neosalvarsan almost invariably presented a positive reaction regardless of the number of doses of the drug given or the time interval between the last injection and the performance of the test.

Mercury is a therapeutic agent so universally accepted as to need no especial mention.

Bismuth, a younger agent therapeutically, seems to be gaining increased confidence in the profession with the passage of time and appears definitely to belong in the category of valuable anti-syphilitic drugs.

Wallace,[15] of Dublin, in 1836, was apparently the first physician to use iodine in the treatment of syphilis, but Ricord[16] popularized the use of the drug in the treatment of the disease in its tertiary stage. This drug differs from those named previously in that it is not of value as a combatant of the syphilitic infection *per se*. Burke[14] says in this connection: "It cannot be too strongly insisted upon that iodine and the iodides possess no treponemicidal power. . . . Neither iodine nor its salts are treponemicides. Their real func-

* Unpublished.

tion lies in their power of breaking down the fibrous-tissue fortifications behind which, especially in late and endosyphilis, the organism has established itself. Iodides are solvents of fibrous tissue." With the discussion of the rationale of iodine medication, therefore, the subject of discussion changes from the systemic disease to the local lesion.

The pathology of syphilitic ulcers has already been discussed and the reaction by which fibrous connective tissue comes to surround the lesion and interfere with the blood supply and the healing process in general has been mentioned. The value of iodine medication in the healing of luetic ulcers, so far as it is certainly known, is in direct proportion to its ability to release this fibrous connective-tissue fortification and allow the formation of healthy granulation tissue and the speeding of new epithelial covering from healthy marginal skin. It requires but a moment of reflection on the histological picture of the lesion to realize that the drug is likely to be of most value in the earlier lesions in which the amount of fibrous tissue is not great, since it is a matter of common knowledge and experience that no drug can be relied upon to correct extensive histological changes. Furthermore, it has been the experience of the author, and doubtless the experience of most or all of those who have had any considerable experience with luetic ulcers, that ordinary doses of iodine are of little or no value, even in lesions in which there is a relatively small amount of fibrosis.

By ordinary doses is meant the equivalent of five, ten or fifteen grains of potassium iodide three times per day. To be sure, doses of this size can conveniently be used at first to determine the possible sensitivity of individuals to iodides and to accustom them to the régime of iodine therapy, but to make iodide therapy effective, it is usually necessary to increase such doses manyfold. It has been the author's practice to prescribe a saturated solution of potassium iodide by mouth in initial doses of ten, or, more frequently, fifteen minims three times a day, dissolved in water or preferably in milk, three-quarters of an hour to an hour after meals (in order to minimize the irritant effect of the drug on the gastric mucosa) and then to increase the dose by several drops at intervals of two or three days until the patient takes three times a day from sixty grains of potassium iodide upward. It might be supposed that such doses would predispose to the rapid development of iodism, but experience indicates that such is actually not the case. On the contrary, individuals who are seemingly intolerant to the smaller doses of the drug frequently find no difficulty in taking and assimilating the larger doses without toxic effects of any kind. Some of the author's patients have taken and are taking between 1 and 200 grains of potassium iodide three times a day in this manner. Doses of 500 to 1,000 grains three times a day can be taken at least by certain patients if such doses seem to be warranted. Such doses are rarely or never indicated for patients with syphilitic leg ulcers but are quite routinely given in cases with actinomycotic infections, a fact which is here mentioned simply to substantiate the feasibility of using relatively large doses of the drug.

Lately I have been using sodium iodide intravenously in some cases. The series of patients from which the particular cases under discussion were taken are the poor and indigent, not to add the ignorant and slovenly. The cost of potassium iodide in the case of some of these patients is a serious financial burden and in some cases is actually prohibitive. Although it has usually been possible for those without financial means of their own to procure the drug through charitable sources without cost, nevertheless the amount procurable at any one time has invariably been so small as to discourage the patient in replenishing his stock as it became exhausted. The result has been that in some cases I never could feel quite sure that although the drug had been ordered, it had been actually procured and taken by the patient according to instructions. Accordingly, in those cases in which I had reason to believe that the iodine medication was not being scrupulously followed, I have adopted the intravenous method. Smaller doses have been given in the beginning, but the average therapeutic dose is the contents of a twenty-cubic centimetre ampoule of sodium iodide in 5 per cent. solution; *i.e.*, about thirty-three grains. The injection is, of course, made under aseptic precautions and proceeds very slowly. To insure this latter state of affairs, I prefer to inject with a small hypodermic needle. In a few cases, I have seen syphilitic ulcers heal promptly under intravenous iodide therapy, although they had been quite resistant to treatment *per os*.

Adequate anti-syphilitic treatment, *i.e.*, the adequate usage of the arsphenamines, mercury, bismuth and the iodides, does not by any means invariably lead to marked improvement in the local lesion. I have seen recent ulcers in patients with strongly positive serological reactions heal very kindly and rapidly under the influence of vigorous treatment by these drugs. I have seen ulcers of longer duration in syphilitic patients improve slightly under such medication, and I have seen other ulcers, both of long and short duration, which appeared to be absolutely uninfluenced by the anti-syphilitic treatment, in spite of the fact that they were definitely luetic by every rule of diagnosis. Although, therefore, anti-syphilitic treatment and the use of iodides in large doses is indicated in every case of syphilitic ulcer or suspected syphilitic ulcer, the results of such medication may or may not be satisfactory. In my experience, I have found that in only a relatively small proportion of really chronic cases could this form of medication, no matter how vigorously pushed, effect a cure of the lesion. If it were not so, there would be no excuse for the considerable literature which has grown up on the subject of therapy.

Local treatment.—Local treatment of syphilitic ulcers is designed to accomplish one or the other or both of two ends: (1) To control secondary infection, and (2) to promote healing.

Because of the fact that the syphilitic ulcer is a relatively painless lesion, that it occasions no incapacitating disability, and that it may not be unduly large at first, patients in straitened circumstances, patients possessed of limited intelligence, and those careless in matters of personal hygiene, fre-

quently undertake the treatment of the early lesion themselves, and only after they have exhausted their own resources and those of their immediate and sometimes more distant acquaintances, may they present themselves to a physician for treatment. For this reason, most syphilitic ulcers at the time they first come under observation present all the manifestations of secondary infection. For the same reason, many of these lesions also present a thickened, indurated, fibrotic base and edges; in short, a picture not essentially different from that of the so-called "callous" ulcer. It is only by carefully rationalizing the local treatment with reference to the specific ends to be accomplished that one can hope to achieve ultimate success.

To those of limited experience and, to some extent, also to those who have grown weary in the treatment of chronic leg ulcers, the selection of suitable medicinal agents and the technic of the application of those agents to the local lesion may seem of considerable importance. There are still many who talk and write enthusiastically about salves, ointments, lotions, pastes and powders. I have yet to see the more commonly used and better known of these agents do any gross harm, but I have tried numbers of them and have seen many different preparations used by others without improving the patient's condition at all, and this in spite of the fact that the patient's reaction was almost invariably in favor of the preparation most recently used in his case. The patient with the chronic leg ulcer almost constantly has an optimistic attitude, and I believe that it is in some part, at least, the contagion of this attitude which has prompted the enthusiastic endorsement of such preparations by the medical profession itself in the past.

If these agents are used for their germicidal value, the confidence of the person who uses them is almost certainly misplaced. It is now pretty generally accepted that effective germicides destroy the tissue of the host with the same measure of avidity with which they destroy the bacterial invaders, and, indeed, were it not so, germicides applied to surfaces are capable, in the very nature of events, of destroying only the surface bacteria. These bacteria, furthermore, are precisely those bacteria which cause no real harm, only those bacteria which have been engulfed by actively motile polymorphonuclear leucocytes and have been carried into the deeper tissues by way of the lymphatics being in a position to do active harm. Those applications which are bacterially inert may be harmless or harmful, depending upon their physical characteristics.

Ointments and salves tend to keep dressings from adhering to the ulcer and allow more or less free motion of the skin below the dressing while the dressing is in place. For this reason, they are soothing, and to some extent facilitate redressing from time to time. If, however, there is an active infectious process in the ulcerated tissue, the advisability of smearing the area with any substance impervious to water seems to be somewhat at variance with the accepted principle of treating infections. The case for powders and lotions belongs in the same category.

In the light of war-time and post-war-time experience, it would seem that the rational method of procedure in any open infected lesion is the method which has sometimes been called "physiological antisepsis." This consists of the application to the lesion of sterile compresses of hypertonic salt solution, preferably in the case of such lesions as chronic leg ulcers, in the form of hot sterile gauze compresses. The rationale of the hypertonic salt solution compress cannot be detailed in this place and still preserve the proper equilibrium of the discussion, but Fleming's[17] excellent discussion on "The Action of Chemical and Physiological Antiseptics in Septic Wounds," though published in 1919, is still a classic and worthy of the perusal of anyone interested in the subject.

The control of sepsis in syphilitic ulcers is usually not difficult when using this method. My custom is to instruct the patient to procure a clean basin, preferably a new earthenware basin, and to fill with water, using a clean quart milk bottle to measure the amount of water added, then to add to the water two heaping tablespoonfuls of common salt (sodium chloride) or four heaping tablespoonfuls of epsom salts (magnesium sulphate) for each quart measured, then to place the basin or pan over the fire and boil the solution, subsequently allowing it to cool somewhat before use. The patient is then directed to pour this solution over a voluminous dry gauze bandage previously applied in the clinic. Such a solution contains about 6 per cent. of the salt added and is sufficiently hypertonic. Boracic acid is considerably less soluble even in saturated solution and incidentally is somewhat more expensive. For these two reasons, I do not consider it particularly suitable. Patients are usually instructed to make applications at intervals of one hour and to keep the dressing saturated with the hot solution for a period of half an hour at a time. Within a few days, if this treatment be persistently followed, almost any leg ulcer, even though grossly infected, can be very effectively sterilized.

For the stubbornly resistant varieties of infected ulcer, there is no alternative but to put the patient to bed, subject him to permanent elevation of the affected part, and treat the local lesion vigorously according to the principles previously enunciated as suitable for ambulatory patients until the process is well under control. I have never seen a case of luetic leg ulcer so badly infected that it failed to respond to this form of treatment. When local infection has once been brought under complete control, every effort should, of course, be made to prevent secondary contamination and an exacerbation of the original infectious process.

With the sterilization of the ulcer, the therapeutic goal changes to the stimulation of the process of repair. As all those who have had much experience with the treatment of chronic leg ulcers know only too well, the medicinal agents, ointments, powders and lotions previously mentioned as being inefficient in the control of infection are even less efficient in the stimulation of the process of repair. This process is essentially one of the growth of new connective tissue and new epithelium to fill the hiatus left by the detachment of the gumma. Inasmuch as the growth of both varieties of tissue is dependent

upon adequacy of blood supply, no form of treatment can be expected to succeed which fails to take into consideration and overcome the tissue changes which militate against adequate vascularization of the area.

In many cases, failure of the lesion to heal seems to be due mainly to a more or less chronic venous congestion of the part, and this is frequently associated with some degree of localized or generalized tissue œdema. If all cases showing such vascular disturbances could be put to bed immediately and then could be actively treated by elevation of the part and the application of dry, or, better, moist heat, probably healing would progress rather satisfactorily in many instances. The nature of the lesion, however, and frequently also the financial status of the patient as well is too often such that this form of treatment is considered impracticable.

Altogether too frequently when this conclusion has been reached, it is tacitly assumed that nothing can be done for the vascular disturbance. The attendant's attention becomes focussed on the local lesion and the condition of vascular embarrassment receives no attention at all. Inasmuch, however, as the healing of leg ulcers depends upon adequate vascular circulation not only of arterial and venous blood but also of lymph, such an attitude is invariably detrimental to the patient's interests, and the local lesion goes rapidly from bad to worse, regardless of the painstaking regularity with which dressings may be applied.

It cannot be too strongly emphasized that much can be done for the patient whose leg ulcer is associated with vascular stasis of the extremity, even though such a patient cannot or will not submit to prolonged recumbency. The problem in the ambulatory patient may be attacked from the following points of view: (1) That of lymph stasis, (2) that of arterial blood supply, or (3) that of lymph stasis and venous stasis conjointly. The procedures which may be adopted are: (1) Lymphangioplasty for the lymph stasis, (2) a Leriche procedure to increase the arterial blood supply, or (3) the application of some form of molded elastic support to the extremity to combat both lymph stasis and venous stasis. The first two procedures are only in the experimental stage and seem to the author to offer very little prospect of benefit in most cases of luetic leg ulcer. The last procedure is technically less difficult and from the practical point of view proves exceedingly efficacious in many cases.

Lymphangioplasty.—According to Mason,[18] the important prerequisite for the healing of chronic ulcers of the leg is the institution of adequate drainage for tissue fluid which accumulates in the tissue spaces surrounding the ulcer. Thus, when Mason speaks of drainage, he does not mean superficial drainage of the ulcer surface, but a drainage of the sodden tissues forming the ulcer bed. He calls attention to the fact that although lymphangioplasty has not been accepted as a proper form of treatment for œdematous legs, the seat of chronic ulceration, the operation has been applied with benefit by both Handley[19] and Clark [20] in the treatment of œdema of the leg without ulceration. He refers to the classical work of Kondolion and states that the object

of lymphangioplastic operations is to form an artificial means of communication between the superficial lymphatic chain of vessels which course superficial to the deep fascia, and the deep chain of lymphatics which course deep to this fascia, there being normally no considerable intercommunication through the fascia itself; the fascia forms a tubular investment for the muscles of the leg and thus separates rather distinctly the one group from the other. Mason's operation is a rather simple one. He uses two or three pieces of No. 12 silk suture material. He passes the silk on a probe through the superficial œdematous tissues, to and through the deep fascia into the deep muscular plane; he allows these pieces of silk to remain *in situ* until new lymphatic channels have been created along the course of the silk ligature as a guide. He emphasizes the importance of assuring one's self that the deep ends of these pieces of silk have actually been thrust deeply into the musculature and have not been allowed to become subsequently displaced into the subcutaneous tissues. Mason has treated several cases of chronic callous ulcers in this manner with apparently excellent results. The author has never had occasion to try the method, but it would seem to be entitled on the basis of common sense and Mason's endorsement to further trial by other persons who have to deal with the ulcer problem.

Operations on the sympathetic supply to the part.—The popularization by Leriche[21] of the idea that the operation of periarterial sympathectomy is capable of markedly increasing the arterial blood supply to the extremities has stimulated much experimentation with respect to the potentialities of the operation in the treatment of a variety of conditions. Chronic leg ulcers have been no exception. It was the teaching of Leriche that the operation of periarterial sympathectomy causes interruption of the vasoconstrictor nerve fibres supplying the part of the body distal to the site of operation and thereby tends to flood the part with arterial blood. Ford[22] conceived the idea that such an augmentation of the blood supply of the lower extremity was precisely what seemed most needed in the treatment of chronic leg ulcers. Ford thought, however, that actual periarterial sympathectomy performed with a knife might be less successful in accomplishing this end than a somewhat more simple procedure; *viz.*, the interruption of the periarterial sympathetic nerve trunk by chemical means. Following the lead of Sampson Handley,[19] who produced chemical section by injection of alcohol into the wall of the artery, Ford proposed this practice in the treatment of leg ulcer since it would seem to be simpler than section with a knife and also since Leriche had apparently shown that the vasodilator effect of mechanical sympathectomy was transient, not lasting for more than a month at best. Arguing from the premise of the prolonged effect of alcohol injections in the treatment of trigeminal neuralgia, Ford thought that the use of alcohol should produce a more prolonged reaction. Although Ford tried this procedure clinically in but one case, the results in this case were particularly gratifying and he expressed his intention of making the procedure an object of further assay.

Mechanical supports to the vascular system.—When attempting to produce conditions favorable to the repair of chronic leg ulcers by the use of artificial supportive devices to the part, attention should be paid to the fact that the end to be achieved is support to the entire vascular system of the extremity below the knee. Local supportive devices applied to the region of the ulcer alone are of relatively little value because the vascular disturbance itself is not limited to the area of ulceration. Accordingly, the local application of such devices as "crisscross," or "basket," strapping of the ulcer with adhesive plaster and the local use of elastic pressure, as by balloons or pieces of rubber sponge, is apt to be disappointing. On the other hand, any mechanical appliance which provides firm and even elastic pressure to the tissues from the base of the toes to the bend of the knee is almost sure to be of great benefit.

The elastic stocking is a good example of such a device, but due to the original expense of obtaining a stocking with an accurate "fit," the fact that the fabric of which it is made is apt to deteriorate and the contour of the part is apt to change, and other considerations, the elastic stocking is not by any means an ideal appliance.

Various substitutes for the elastic stocking have been devised, some of which are deserving of a word of mention, especially the washable rubberless elastic bandage and elastic adhesive plaster.

There are two contrivances, however, which are very efficient, can be made available anywhere, and do not place the surgeon at the mercy of any manufacturer or distributor of special apparatus—the adhesive-plaster strapping of Gurd[23] and the plaster stocking or boot of Unna.

Gurd's procedure supersedes most other devices in efficiency, particularly if elastic adhesive plaster is used instead of ordinary adhesive plaster. The procedure which he recommends is as follows: The leg is thoroughly bathed in a solution of washing soda and is thereafter thoroughly scrubbed with soapy water and a soft brush. The leg is then washed with petroleum ether either immediately, or after the application of alcohol; the purpose of the alcohol is to dehydrate the superficial layers of the skin. The patient then is required to lie on his back with the leg elevated nearly perpendicularly against the wall for a period of from thirty minutes to two hours or until all œdema has disappeared. With the leg still elevated, strips of zinc oxide plaster, from 2.5 to 3.5 centimetres in width and sufficiently long to overlap when passed circularly about the leg, are applied beginning at the base of the toes and ending just below the knee; successive circular strappings are made to overlap the preceding one by at least 1.5 centimetres. The strapping is carried directly over the ulcerated area. Gurd says that the heel need not be covered but makes an especial point that the strapping should extend upward on the leg as far as the attachments of the fascia to the tuberosities of the tibia and the head of the fibula. Such an appliance lasts on first application from about four to ten days; thereafter, it is usually effective if changed only every two or three weeks. Reapplications of the dressing follow exactly the same routine as the first application.

When properly applied, the Unna's plaster stocking is by far the best device of all. Many of those who have contributed to the literature on the subject of chronic leg ulcer have spoken very highly of this device (White,[1] Thomas,[24] Strickler,[13] Eloesser,[2] Ochsner and Garside.[6] The method of preparation and application of this device has been described in a number of different places and need not here be repeated.* Among other advantages, this device possesses the following: (1) It is semi-elastic and yet rigid; (2) it is relatively inexpensive; (3) it can be prepared and applied by almost everyone and almost anywhere; (4) it is a custom-made device which fits the part perfectly and provides diffuse but adequate support over the entire extremity below the knee; (5) it is fashioned to fit the individual patient, being molded to the shape and size of his particular extremity; (6) it cannot be removed and replaced by the patient without the knowledge of the physician; (7) when it becomes soiled or ceases to perform its proper function, it is cut away and discarded without hesitation or compunction, because it is relatively cheap.

Plastic operation.—Plastic operations attempt to attack the problem from a much more direct angle than any of the preceding forms of treatment. The problem is immediately shorn of much of its technical difficulty by the assumption that the essential features in the case are a denuded area of the body, which the body is unable to fill in the usual manner with granulation tissue and epithelium by virtue partly of its size, partly of its location, and partly because of other factors, chiefly a zone of fibrous connective tissue interposed between the ulcer itself and the adjacent normal tissues from which vascularization and the formation of new tissue must in the nature of events eventually come.

It is assumed by those who advocate plastic operations that chronic syphilitic leg ulcers can be cured like other lesions which involve extensive destruction of tissue by careful skin grafting of the area after adequate preparation of the field for grafting. I am well aware that the solution of the problem is probably not actually as simple as it looks at first glance, but largely because of the pioneer work of such surgeons as Long,[25] Carnett,[26] Douglas[27] and others, I have come to believe that the idea of primary grafting in the case of chronic syphilitic ulcers is fundamentally sound and should be more frequently adopted. I am strongly of the belief that luetic ulcers larger than one inch in diameter should be subjected to skin grafting just as soon as adequate anti-syphilitic treatment has been provided and infection has been controlled, without waiting to determine what effect other forms of local treatment may have. Furthermore, I am convinced that all ulcers, even though they be much smaller than this, should be subjected to skin grafting within a month or six weeks, provided they do not show a rapid tendency to heal under the ordinary forms of treatment previously described.

* Anyone to whom the Unna's paste boot is unfamiliar is referred to: Cutting, R. A.: Chronic Leg Ulcers. Treatment with Unna's Paste Boot. Amer. J. Surg., vol. viii, p. 743, 1930.

I do not, however, believe that skin grafting will assume its legitimate place in the treatment of this condition until the following facts are realized: (1) That patients with chronic leg ulcers are properly subjects for the early attention of the surgeon and are not to be referred to him only after long-continued conservative treatment has been tried in vain and has vitiated his best opportunity to be of use; (2) that the patient with chronic leg ulcers has as much right to a bed in a hospital and as great a claim on the time and study of the surgeon as does the case with chronic osteomyelitis, acute appendicitis, cholecystitis, or any other of the surgical maladies which keep the ward beds in a hospital filled; (3) that hospitals and doctors alike profit as much by adopting a form of treatment which promises an early successful result as does the patient, because otherwise the repeated calls of the patient on the time of the staff or the individual, as the case may be, actually consumes a far greater amount of time and material—in other words, expense—than a concerted marshalling of medical resources for a relatively short period of time at the outset.

Half-hearted attempts at plastic repair of chronic leg ulcers cannot be expected to yield a high percentage of satisfactory results; by this I mean the somewhat grudging admission of the patient to the hospital for a few hours of preliminary treatment, the spreading of Thiersche grafts over the base of the ulcer without due regard to underlying tissue changes, and the early dismissal of the patient to an out-patient service for subsequent care. It is true that a certain percentage of patients treated in such a manner are temporarily relieved of their open ulceration. A very thin pellicle of unhealthy-looking bluish epithelium spreads over the base of the ulcer. An unsatisfactory form of repair, however, occurs beneath this thin pellicle of epithelium which consists of maximal scar production, the result being that contraction of the part subsequently ensues; the blood supply to the new epithelium gradually becomes inadequate and sooner or later some minor scratch or abrasion at the site of the old ulceration serves to rekindle the original process, and the entire area reulcerates.

In order to perform the operative procedure properly, it is necessary to admit the patient to a hospital in good faith for a period of time as long as may be required to study his individual case and completely rehabilitate the patient. The first few days of stay in the hospital, apart from the routine matters associated with the elaboration of an adequate physical examination, consist of relieving the affected extremity of œdema and engorgement by constant elevation of the part on pillows. At the same time, any associated secondary infection of the ulcer is energetically treated, either by the use of hot hypertonic salt-solution compresses, or, perhaps even better in certain cases, by the Carrel-Dakin technic.

As soon as the clinical manifestations of secondary infection have subsided, daily bacterial examinations are made until the bacterial count in the lesion indicates that it is ready for an operative procedure and that this procedure can be performed without danger of rekindling latent infection. As

soon as this condition has been found to exist, the surgeon dons a pair of sterile gloves and proceeds to determine by careful manipulation of the area the extent of the preliminary excision of tissue which must be made in order to provide a satisfactory bed for subsequent grafting. The amount of tissue which must be cut away depends upon the amount of fibrosis which has occurred, for sufficient tissue must be removed to expose a relatively normal and adequately vascularized area from which healing can take place. By grasping the margins of the ulcer between thumb and finger of the gloved hand and by gentle exploration of the base of the ulcer with the examining finger, a very satisfactory determination of this point can be made rather speedily. The first stage of the operative repair can now be completed. This consists merely in the excision of the required amount of tissue and the control of hæmorrhage from the base of the new ulcer thus created. Sterile dressings are then applied to the area and the patient is returned to the ward, whereupon the limb is elevated as before and the new ulcer is allowed to fill for a number of days with clean, healthy, non-infected granulation tissue.

The amount of time required for this process varies considerably, but frequently consumes two or three weeks. During this period of time, if the granulation tissue tends to become exuberant, it may be slightly cauterized with a stick of fused silver nitrate, or if the granulations appear soft and friable, they may be stimulated and hardened by the application of sterile hypertonic sodium chloride solution in a strength of about 10 per cent. As soon as it is believed that a good bed of granulation tissue has developed, the patient is again taken to the operating room for the last stage of the operation, which consists of the actual grafting.

The type of skin graft to be used will undoubtedly vary with the individual preferences of the operator. The thick and the thin, the small and the large grafts, all have their advantages and disadvantages, and it is only by a careful weighing of these advantages and disadvantages in any given case that the operator can determine the proper methods for use. The pedicle graft would be ideal if the area to be grafted were the only consideration. Unfortunately, about the only place from which a pedicle graft could be taken in these cases would be the same or the opposite leg. If the opposite leg is chosen and it has a defective blood supply, the pedicle itself is apt to slough before it takes, and in any case, a large defect is left on the sound leg which must subsequently be made to heal or else the patient simply exchanges a chronic ulcer on one leg for a chronic ulcer on the other. The Thiersche graft usually takes well and leads to healing in a relatively large number of cases. However, the resulting layer of protective epithelium is thin; it becomes injured easily and it resists infection poorly. The small deep graft usually takes satisfactorily, but it produces an unsightly scar and it fails to prevent contractures from developing. Full thickness grafts are ideal from the points of view of healing, cosmetic effect, and prevention of contracture, but they may easily be completely lost if post-operative infection occurs.

All of these objections, however, are merely relative, and considering the

highly unsatisfactory character of other kinds of treatment for the resistant luetic ulcer, even a poor choice in the matter of skin grafting methods often results in a relatively satisfactory end-result.

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TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

STATED MEETING HELD MARCH 9, 1932

The President, Dr. John Douglas, in the Chair

BLEEDING DUODENAL ULCER—RECURRENT

Dr. Edward J. Donovan presented a man, aged twenty-four years, who was admitted to the Medical Ward of St. Luke's Hospital, January 8, 1932, with a history of having been operated upon in another hospital May 13, 1929, for perforated duodenal ulcer. Previous to this he had had ulcer symptoms for about one year. A simple closure of an anterior-wall duodenal ulcer was done. One year later he began to have his old distress after eating and often induced vomiting to obtain relief. He was readmitted to the same hospital where a duodenal tube was passed, and he was fed through this for two weeks with relief. Last May he again began to have distress. Since this time he has adhered strictly to an ulcer diet but has remained only fairly comfortable. Three days before his admission to St. Luke's, his pain became severe, and he noticed a tarry stool for the first time. His stools have remained tarry ever since. He has had considerable pain in his epigastrium, but a feeling of weakness and vertigo has probably disturbed him more. His blood count on admission was: red blood-cells, 2,900,000; hæmoglobin, 58; white blood-cells, 6,000; polymorphonuclears, 80; and lymphocytes, 20. He was transfused and starved for forty-eight hours. As soon as the bleeding stopped he was put on Lenhart's diet. For four days his stools were negative for blood, but they again became positive and tarry and his hæmoglobin dropped from 68 per cent. to 55 per cent. He was then transferred to a surgical service. Operation January 26, 1932, showed an anterior-wall duodenal ulcer and also a hard, indurated posterior-wall duodenal ulcer with a blood-clot in the centre showing definite evidence of recent bleeding. An incision was made one inch above the pylorus; a finger was inserted into the duodenum and two ulcers were palpated; the incision was prolonged into the anterior wall of the duodenum, excising an ellipse including the anterior-wall ulcer and one-half the pyloric sphincter. A posterior-wall ulcer of large size was excised with a cautery and the edges were closed with continuous chromic suture. The cut edges of the duodenum were then sutured to the cut end of the stomach with three rows of chromic, the suture line being at right angles to the long axis of the stomach to prevent constriction. The mucosa was sutured as a separate layer as this is more strictly hemostatic, and in this way it is unnecessary to turn in as much of the edges as it is with ordinary suture. At the end of the operation the new pylorus easily admitted three fingers; a jejunostomy was then done for feeding purposes by the insertion of an 18 French catheter about six inches below the duodenal jejunal juncture. The tube was passed through the omentum and out the lower angle of the incision.

Convalescence was disturbed slightly by post-operative pneumonia, which started on the second post-operative day. His temperature was normal four days later, and his convalescence was most satisfactory from that time. He was given nothing by mouth for forty-eight hours. Then water only was given in small quantities for the next thirteen days. Feeding was started

through his jejunostomy tube twenty-four hours after operation. The feeding consisted of milk, two ounces; alternating with peptonized milk, two ounces, every two hours. This was increased until he was getting five ounces every two hours. He thrived on this diet, and on the fourteenth day small feedings were started by mouth and the feedings through the tube continued. As mouth feedings were well tolerated, the tube was closed for twenty-four hours and then removed. There was no leakage around it. His stools have been negative for blood since operation. His blood count now is red blood-cells, 4,750,000; hæmoglobin, 83. He has gained sixteen pounds in weight.

In the ANNALS OF SURGERY, 1930, Judd reported 464 cases treated this way, nine cases of which were operated upon later for failure to relieve symptoms. Three cases only were reoperated upon for gastric retention.

DOCTOR DONOVAN presented a second case, being a man who was first admitted to the Medical Ward at St. Luke's at the age of fifty-five years March 2, 1927, complaining of tarry stools and vomiting blood. He was transfused; no evidence of ulcer could be demonstrated. He was discharged at the end of two weeks. He was readmitted nine and one-half months later for the same complaints, transfused again and explored. An anterior duodenal ulcer was demonstrated which was excised and a pyloroplasty done December 24, 1927. He did fairly well after this and returned to work. Four months later he was readmitted to the Medical Ward with the same symptoms, that is, vomiting blood and tarry stools. He was transfused twice; bleeding continued; a gastrotomy was done but no source of bleeding was found. A biopsy of liver was taken and his appendix removed. His convalescence was uneventful, bleeding stopped and he remained fairly well until November 5, 1931, when he fainted, vomited large amounts of blood and had tarry stools. He was transfused three times and operated upon again December 7, 1931. At this time his blood count was red blood-cells, 3,300,000; hæmoglobin, 66. A posterior duodenal ulcer of large size with indurated walls was found about one inch beyond the pylorus. A posterior Polya resection was done, excising that part of the duodenum including the ulcer. His convalescence was uneventful, and at present he is free from symptoms. His blood count now is red blood-cells, 4,800,000; hæmoglobin, 75. Fluoroscopy March 3, 1932, showed stoma functioning well, stomach emptying rapidly, no spasm, no dilatation of the intestinal part of the anastomosis.

DOCTOR DONOVAN presented a third patient, a man aged forty-four years, who was operated upon in December, 1919, by Doctor Downes, and an anterior-wall duodenal ulcer excised. He remained entirely free from symptoms for the next nine years. Two years ago he began to have some discomfort in the epigastrium, but it was never localized and was relieved by milk or soda. With care about his diet he remained fairly comfortable until last August, when his pains got worse and he was put on a milk diet. He received some relief from this diet when he took it every two hours. His pain was always worse at night, and he vomited regularly about once or twice a week with relief. He continued this régime until December 20, 1931, when he was admitted to St. Luke's because of the severity of his pain. He was kept in bed for three weeks on Lenhart's diet, but he did not feel relieved at the end of this time. An X-ray showed a penetrating duodenal ulcer. He was operated upon January 8, 1932, when anterior- and posterior-wall duodenal ulcers were found, the latter having penetrated the pancreas.

There was considerable acute inflammatory reaction around it. A posterior Polya was done, excising that portion of the duodenum bearing the ulcers. He is now free from symptoms.

Fluoroscopy, March 7, 1932, showed stoma open; stomach emptying rapidly; no dilatation of the intestinal loops and no spasm around the stoma.

BLIND POUCH GROWTH OCCURRING NINE YEARS AFTER PARTIAL COLECTOMY WITH LATERAL ANASTOMOSIS

DR. OTTO C. PICKHARDT presented a young girl who was admitted to Lenox Hill Hospital, February 20, 1923, aged five years. She was shown before the New York Surgical Society, February 23, 1927, as a case of cecal ulcer with lymph-node hyperplasia, simulating sarcoma (four years post-operative) (see ANNALS OF SURGERY, vol. lxxxv, No. 6, June, 1927). She underwent two operations in March, 1923. *First.*—Ileocolostomy (transverse colon), with lateral or side-to-side anastomosis. *Second.*—Resection of terminal four inches of ileum, cæcum, ascending colon and three inches (about half) of transverse colon. In other words, the intestine which had been short-circuited in the first operation, due to pathological changes, was removed. The child made a good recovery. She was presented here among other reasons, because:

(1) The extensive large gut resection did not seem to have hindered normal growth.

(2) The small blind pouch, left at the hepatic end of the transverse colon, had practically doubled itself in size. Whether this was because of natural gas distension or because of normal growth in the large intestine, was not clear. The question was asked, "Will this blind pouch continuously increase in size and will it finally cause abdominal symptoms?" Up to now, the answer must be "no."

At that time the relative size of the other blind pouch—the distal end of the small intestine—presented because of the lateral anastomosis, was not taken cognizance of.

This same patient is now presented again, after a five-year interval, to show: that the extensive resection has not hindered her in her normal growth, either physically or mentally. She is now fourteen years old (eight years and eleven months post-operative). In height she is 62.5 inches, the average being 60.3 inches. Her weight is ninety-six pounds, the average is 100.3 pounds. She is therefore two inches taller and four pounds lighter than the average normal girl of her age. She has always been a very active child, both physically and mentally. Her bowels move, either once or twice daily, without medication of any sort. Her wounds have remained firm and well-healed, and no herniæ are present.

The growth in the blind pouches is as follows: (A) *Large intestine.*—This pouch has changed comparatively little in length; measuring now approximately twelve centimetres as compared to nine centimetres five years ago. This would appear as a rather normal amount of natural growth, remembering also that the normal peristaltic wave would tend to empty this pouch.

(B) *Small intestine* (blind pouch).—Here we find a different condition. Approximate measurements show five years ago a length of fourteen centimetres which now has risen to approximately twenty-two centimetres, practically a 50 per cent. increase. In width it has increased from three centimetres to four centimetres. The general impression is that this pouch now, as a whole, is from one-half to two-thirds larger than five years ago, particularly in its distal club-shaped portion. Here the patient has to con-

tend not only with normal growth but also with the hydrostatic pressure of the isoperistaltic-driven fluid fecal content.

In the eight years and eleven months since the first operation, the ratio between these two pouches is at least one to three.

This larger, small intestinal pouch, then, rather than the smaller, large intestinal one, appears as a menace and a potential source of danger, from the standpoint of obstruction, either within itself or to other portions of the intestinal tract.

Dr. DeWitt Stetten remarked that he would give serious consideration to the question of resecting these blind pouches. Some years ago he had the opportunity of observing a case of Doctor Kammerer's in which there was a perforation of such a pouch after a partial exclusion. The operation of resecting these pouches ought not to be difficult and should be devoid of any great risk. He believes that perforation is not an unlikely occurrence, especially where the peristaltic movement is toward the blind end.

Dr. Allen O. Whipple said that he had occasion to operate a year and a half ago on a patient with a large ileal pouch due to a chronic inflammatory process in the mesenteric glands resulting in shutting off of the ileum. The patient came from Ireland and was found to have had the condition for at least twelve years. The interesting feature was that she had developed evidences of intestinal stasis and typical pellagra. Some twenty-four cases have been reported in which ulcerative conditions of the intestinal tract have been associated with manifestations of pellagra, and that is one possibility that should be considered in these cases.

Doctor Pickhardt, in closing the discussion, referred to the size of the intestine in children and adults. In 1923, John Bryant wrote an article, "Observations upon the Growth and Length of the Human Intestine." From this article Doctor Pickhardt quoted the following observations.

Length of intestines apparently must be correlated to four known factors, *i.e.*, body length, age, sex, and disease.

In the adult, colon length about equals body length, the small intestines being about four times the length of the body.

In the child, the question of sex makes no difference in regard to intestinal length.

Without exception, all male and female children examined, of a body length greater than sixty centimetres, had already acquired a small intestine longer than the minimum length compatible with prolonged adult life. But at this same early period of life, these children had not yet acquired much over half the corresponding length of colon.

Not later than the tenth year of age, practically all the children examined had already acquired both small intestines and colons of lengths such that had they been found in the adult, they would have been classified as within the normal adult limits of intestinal length.

It would appear then, that from the tenth year of age onward, intestinal growth is an affair primarily not of increase in actual length, but of increase in area through increase in calibre.

The child of ten years of age has both a small intestine and a colon of a length considered normal for the adult.

Growth of the intestine after ten years of age is an affair primarily not of growth in length, but of growth in calibre.

In the adult, the male has a small intestine and colon about 6 per cent. longer than the general adult average. In the female, the small intestine is about 5 per cent., and the colon about 10 per cent. shorter than the general adult average.

The normal average length of the small intestine in the adult may be considered as 6.11 meters or twenty feet six inches. The normal average length of the colon in the adult may be considered as 1.52 meters, or five feet two inches.

ECHINOCOCCUS CYST WITH CALCIFIED ADVENTITIA—COMPLETE REMOVAL

DOCTOR PICKHARDT presented a man, forty years of age, Hungarian, who was admitted to Lenox Hill Hospital, August 7, 1930. Had been in the United States for twenty-six years, with one visit to Europe two years ago. During this visit he developed a fever with indigestion and alternating attacks of severe diarrhœa, and constipation. At present he has a continuation of these symptoms for which dispensary treatment has been unavailing. Loss of weight from 202 pounds to 152 pounds. His abdomen was somewhat full, particularly on the right side. Just below the right costal margin, more toward the mid-line, was a deep, large, rounded mass, projecting from under the liver edge, which could be felt as a hard, smooth, and distinct line. This mass moves with respiration. It is attached to the liver and is not particularly tender. White blood-cells, 9,750; polymorphonuclears, 66 per cent.; eosinophiles, 3 per cent. Echinococcus fixation test—negative. Icteric index —8.0. Van den Bergh—negative. Wassermann—A:O; + C:O.

Röntgenogram.—Graham test.—The gall-bladder fills and is seen to be on a level between tenth and eleventh ribs. It is displaced upwards by a rounded mass, apparently arising from the lower and outer border of the liver. The gall-bladder functions well.

Operation.—August 14, 1930, by Doctor Pickhardt:—A Kocher subcostal incision was made on the right side. This exposed a large, grapefruit-sized, hard, round tumor mass, arising in the lower border of the left aspect of the liver, and impinging against the intestines below. The cyst extended backwards into the lumbar region and to the vertebræ. When the adventitia was opened an uncountable number of thin-walled transparent cysts containing fluid and ruptured cysts of various sizes were found. These were scooped out with a large spoon until the cavity was clean. The cavity was then sprayed with ten cubic centimetres of pure formalin which was then wiped out and the same procedure again done with 90 per cent. alcohol. The cavity was then packed with iodoform gauze after the edges of the adventitia have been marsupialized to the skin.

The cysts contained a cloudy, watery fluid whose turbidity was apparently caused by small white particles.

Microscopical sections of the daughter cysts showed healthy scolices of *tænia echinococcus.*

For the first two weeks after the operation there was the usual amount of discharge from the wound, then a foul odor became apparent, and then bile appeared on the tampon. During the next five weeks, the amount of discharge continued the same and in spite of various irrigating solutions the odor became more foul. Occasionally, a few small calcified placques would come away. The condition as far as healing was concerned had come to a standstill, and the external opening was so contracted that it did not allow proper drainage. The interior of the cavity was lined with gritty, calcium deposits which kept the walls rigid and did not allow obliteration of the cavity.

October 15, 1930, two months and two days after the first operation, the old wound was enlarged at either angle. This exposed a cavity the size of a small grapefruit, lined with a thick connective-tissue sac within which were calcareous deposits, and which was trabeculated and grown into deep folds. No attempt at granulations was present. This adventitia in its

superior aspect was pressed tightly against the liver, and inferiorly and laterally against the peritoneal cavity. A line of cleavage was found and then by means of finger dissection, with considerable difficulty, a thick-walled, firm, hard, cup-shaped membrane, the adventitia of the echinococcic cyst removed at the previous operation, was shelled out except for a small portion at the inferior surface near the skin. Here a too dense connection with the peritoneum made it unwise to attempt removal. A moderate amount of bleeding, particularly from the liver surface, was encountered but was controlled by packing. The cavity was then tightly packed with plain dry gauze and the wound left wide open.

Microscopical examination showed the specimen to consist of a mass of hyaline connective tissue in which were numerous areas of necrosis and calcification. Cellular elements were exceptionally scanty.

There was considerable post-operative shock and rise of temperature for the first four days. Much improved by the seventh day. There had been a moderate bile discharge. This day the original tampons were removed with very little bleeding. The inside of the cavity looked quite clean except for the area at the lower surface where a part of the wall had been left in. Some of this tissue was removed and the wound packed loosely with three gauze tampons. At the end of another week a remarkable change for the better was noticed. The size of the cavity had decreased at least a half and there was a moderate, mild, mucoid bile discharge.

November 22, 1930.—Five weeks after operation the wound was practically healed, having granulated from the bottom up. There was no bile discharge. Echinococcus fixation test was negative. Discharged to outpatient department for further dressings.

February 1, 1931.—Wound has remained healed since the last dressing December 26, 1930. No mass. No evidence of hernia. Still complains of gastric symptoms.

February 12, 1932.—Echinococcus fixation test—negative. Wassermann, negative; blood count: white blood-cells, 5,300; polymorphonuclears, 78 per cent.; eosinophiles, 0. Moderate indigestion symptoms. Some pain in wound on change of weather. Wound firm. No hernia. No return of mass. Condition excellent.

The interest in this case lies in the secondary removal of the thick, partially calcified adventitia, without mishap or complication.

REMOVAL OF ECHINOCOCCUS CYST; ITS INFLUENCE ON SPECIFIC BLOOD REACTION

Doctor Pickhardt present a woman, twenty-nine years of age, born in Germany, who was admitted to Lenox Hill Hospital, July 29, 1929, with the history that thirteen years before admission, she noticed the presence of a lump in the epigastrium. It progressively became larger and at the age of twenty-two years (seven years previous), following attacks of pain and vomiting, laparotomy was performed, in Germany, and encapsulated worms (Hundewurmer) were removed. Following this she enjoyed good health up to three months before admission at which time she had attacks of right upper quadrant discomfort and occasional vomiting, with lump formation as previously.

Examination revealed a large, rounded mass in the right upper quadrant, connected with the liver, and moving with respiration. It extended in the mid-line down to the umbilicus and laterally to the right into the mid flank. It was not particularly tender.

The laboratory tests gave Wassermann: A: 3 plus, C: 4 plus; white blood-cells, 8,400; polymorphonuclears, 37 per cent.; eosinophiles, 6 per cent.

A diagnosis of echinococcus cyst of the liver was made but on account of the concomitant lues, it was decided to give the patient intensive antispecific treatment, pre-operatively. This was done for three months but instead of a decrease in the size of the abdominal mass, it increased, and the Wassermann remained at A: 1 to 2 plus, C: 1 to 2 plus.

The patient was readmitted to the hospital November 20, 1929, for operation.

November 27, 1929, Doctor Pickhardt made a four-inch upper right rectus incision. Because of a previous operation and because of numerous adhesions, it was impossible to enter the peritoneal cavity. A two-way trocar was then inserted into the most prominent portion of the swelling. Immediately a perfectly clear, slightly yellowish fluid, containing a few whitish granules (scolices) exuded under pressure. In this manner, 700 cubic centimetres of fluid were collected in a sterile container; ten cubic centimetres of pure formalin were then instilled into the cavity and allowed to remain for five minutes.

With the trocar in place as a guide, a two-inch vertical incision was made into the cyst outer wall, or adventitia. Within this cavity there was found the real echinococcus cyst which was whitish in color, quite friable and only moderately adherent. By means of strong suction this was completely removed in about three pieces.

Following this, the interior of the adventitia was swabbed out with 90 per cent. alcohol. The cavity was rather lobulated, of a dirty whitish-green character and the thickness of the adventitia at least three millimetres. This cavity was covered superficially by a layer of liver tissue about five to six millimetres in thickness, was in the right lobe of the liver and extended down into the right flank, and was completely walled off from the peritoneal cavity proper. It was lateral to the gall-bladder, the tip of which could be seen indistinctly completely surrounded by adhesions. No daughter cyst of any size was recognizable.

After thorough cleansing of this cavity with saline and suction, two or three times, it was again filled with saline solution by means of a funnel and then the cavity was tightly closed with interrupted chromic sutures. No marsupialization was done. A rubber tube was placed down to the suture line in the cavity and the abdominal wall closed around it.

The post-operative course was uneventful. Very moderate rise in temperature, with slight cough. No definite signs of anaphylaxis as shown by urticaria. There were some indefinite signs of bronchial spasms but not of great moment.

Nineteen days after operation, the patient was discharged in excellent physical and mental condition. Wound is completely closed and well healed.

February 7, 1932.—Echinococcus fixation test, negative. Wassermann, A: plus minus, C: 1 plus. Blood count, white blood-cells, 3,600; polymorphonuclears, 68 per cent.; eosinophiles, 1 per cent. No symptoms, feels well, gaining weight, now up to 156 pounds; no mass.

The points of interest in this patient are: (1) ease of removal of cyst. (2) Closure of wound, without deep drainage. (3) Consistently negative complement fixation test, both pre- and post-operatively, except for one report. (4) A strongly persistent positive Wassermann in spite of intensive antispecific treatment pre-operatively, *but* immediately post-operatively, a drop to negative or at most one plus Wassermann reports, without any further treatments.

Among the various conditions which may cause a positive Wassermann, there is no mention of echinococcus disease.

DOCTOR LEWISOHN referred to a patient whom he had presented before this Society about two years ago after transpleural drainage of an echinococcus cyst of the liver. Nine months ago he removed the cyst by an abdominal route. The patient was seen that afternoon. He is apparently cured.

REPAIR OF INJURED COMMON BILE-DUCT

DR. THOMAS H. RUSSELL presented a woman, forty-two years of age, whom he first saw January 30, 1931. She had been operated upon two days before for chronic adhesive cholecystitis and appendicitis. The gall-bladder and appendix were removed. At this time she was nauseated, the abdomen was moderately distended, her temperature was 101°, pulse 100, and there was a moderate degree of jaundice which was more marked in the sclera. The urine was port-wine color. The blood icterus index was 55.

In view of the possibility of an injury to the common bile-duct he opened that afternoon the wound in the upper abdomen which was done by simply removing all sutures of the abdominal wall. The common duct was easily found and the first ligature which he saw, having fortunately been cut long, was found encircling the common bile-duct just above the point of junction of the cystic duct. There was also a ligature around the cystic duct just distal to the point where it had been cut in the performance of the cholecystectomy. The common bile-duct was gangrenous about the ligature encircling it. The ligature was removed and after making a longitudinal incision in the duct a "T" tube was inserted. A cigarette drain was placed down to the foramen of Winslow and the wound closed in layers with plain catgut. The skin with silk.

The patient made an uneventful recovery. The icteric index was 30 the next day, and 17 two days later. On the twenty-first post-operative day the "T" tube slipped out, and bile drained from the abdominal wound.

The patient insisted upon going home on February 28, four weeks from the day of the second operation.

Four days later, March 4, 1931, she was admitted to St. Francis Hospital stating that the wound continued to discharge large quantities of bile, and that she was troubled with much abdominal distress after meals. Her stools are formed and of natural color. After a few days' rest in the hospital she felt better, until, March 16, there appeared to be slight jaundice. The icteric index was eleven. In a few days the jaundice disappeared and she felt well again. March 31 she was decidedly jaundiced and icteric index was 40.

April 4 the abdomen was reopened by incising the old scar in the upper abdomen and the common duct exposed. A stenosis of the duct for about one inch in length was found at the site of the old trouble. This stenotic part of the duct was excised and an effort was made to bring the two ends of the duct together over a "T" tube. As about one inch of the duct had to be removed at this operation he was unable to get accurate apposition of the ends, hence the chances of a recurrence of the stricture at this site were probable.

As reports of various operations designed to establish a fistula to later anastomose into the stomach have heretofore been unsatisfactory in a large percentage of cases the reporter attempted to try a different procedure which consisted of bringing the long piece of the "T" tube up along the posterior wall of the stomach just proximal to the pylorus, sewing a piece of the gastrohepatic omentum about the tube so as to fix it to the stomach wall with the idea of having a sinus to form along the stomach wall to

later open into the stomach. This was accomplished very easily. The abdominal wound was again closed around the tube and a cigarette drain.

The cigarette drain was removed on the third post-operative day. Bile drained from the abdomen around the "T" tube for several days then ceased. In a few days the "T" tube was pinched off with a Murphy drip clamp for several hours a day until finally the patient was taught to unpinch the clamp for a few minutes night and morning, and to keep the tube in position by means of adhesive-plaster strips.

The patient was discharged from the hospital May 2, 1931. She returned every few weeks for examination until October 20, 1931, when she was readmitted for the final operation. She had gained in weight and stated she felt well and had been doing her usual household duties.

October 23, 1931, icteric index was 10. October 26 the sinus around the tube was dissected free down to where the tube was fastened to the posterior wall of the stomach. A two-inch incision was made through the anterior wall of the pyloric end of the stomach parellel to its long axis, then a stab wound made through the posterior wall of the stomach into the sinus containing the tube. Several inches of the long end of the tube were cut off and the tube pulled through into the stomach.

The tube was then cut off flush with the inner surface of the stomach, but was not removed as the tube had been retained with so much difficulty that it was thought it would soon be discharged into the stomach. The anterior wall of the stomach was closed transverse to its long axis to avoid narrowing of the stomach at this point. The excess sinus was cut off and end sutured. The abdomen was closed without a drain. The patient made an uneventful recovery. November 4, 1931, a flat X-ray of the abdomen showed the tube still in position.

The patient left the hospital November 14 and has returned monthly for X-ray. The last one, taken February 2, showed the tube still in position. She is now feeling well and doing her regular work.

All the above operations were done with spinal anæsthesia, using two cubic centimetres of spinocaine.

Dr. DeWitt Stetten said that in 1914 he had a similar accident in an apparently simple cholecystectomy. The patient was a woman, at that time sixty-four years old, who had a somewhat thickened gall-bladder, containing a solitary ovoid calculus and with a fistulous communication between its fundus and the duodenum. After separating the adhesion between the fundus of the gall-bladder and the duodenum and closing the opening in the duodenum, he proceeded in the usual manner to perform a cholecystectomy, which was by no means especially difficult. After ligating and dividing the mesentery of the gall-bladder, he noticed a rather larger lumen than usual, and, removing the ligature, he found that he had completely divided the hepatic duct transversely. He attributed this accident to an anomaly that is not unusual—namely, a parallelism of the cystic and hepatic ducts. Under these conditions a division of the hepatic duct can very easily occur. Fortunately, Doctor Stetten recognized the nature of the mishap and was able to perform without much trouble an end-to-end anastomosis of the divided duct. The patient made a relatively uneventful convalescence with only slight biliary drainage for a short time. Thirteen years later, in 1927, when the patient

was seventy-seven years old, Doctor Stetten saw her again. At that time she was complaining of what appeared to be a mild attack of cholangitis with slight jaundice and elevation of temperature. She recovered from this under medical treatment and, as far as Doctor Stetten knows, she is still alive and well.

Dr. J. William Hinton said that in reference to a short fistulous tract, he reported a case a few years ago of a woman who had complete obstruction. Direct anastomosis of the common duct to the stomach was done. This was an easy operation to do and the patient made an uneventful convalescence and was shown here seven months after operation. In one year she came back with itching of the skin and was treated in the hospital with biliary drainage. The woman died suddenly from embolus.

Dr. Seward Erdman thought that the method described by Doctor Russell, like all operations which depend on the formation of a connective-tissue tract about a rubber tube, entailed the later probability of scar-tissue contraction. It would be more nearly ideal if the stump of the duct could be implanted directly into the stomach.

Dr. Percy Klingenstein said he believed that whenever possible direct end-to-end anastomosis is the method of choice in dealing with common-duct injuries. He had particularly in mind a patient in whom the common duct had been divided during manipulation incident to the evacuation of many stones in the choledochus, and direct anastomosis over a tube had been done. About a year later reoperation was required for recurrent symptoms of jaundice, chills and fever and the two previously approximated ends were found to be disunited with the common duct full of detritus. The ends were again sutured posteriorly and tube drainage effected. Since that time the patient has been symptom-free except for occasional attacks of pain.

Doctor Russell, in closing the discussion, said that he once had an accident similar to that mentioned by Doctor Stetten but he did an end-to-end anastomosis over a tube and at the end of three months the woman passed the tube and has since remained perfectly well.

POST-PYLORIC ULCER UNDER THERAPEUTIC MANAGEMENT OF INTERNIST, RADIOLOGIST AND SURGEON

Dr. Frederic W. Bancroft read a paper with the above title for which see Annals, December, 1932, p. 1036.

Dr. Henry W. Cave asked Doctor Bancroft how long medical therapy is carried out before failure is admitted. He thought that to take too authoritatively the advice of the röntgenologist is a bad thing. More frequently than not a careful history of the patient and physical examination will mean as much, if not more, than X-ray interpretation. Having the röntgenologist check up with the findings at operation and injecting the specimen with barium is instructive. Doctor Cave expressed his surprise that Doctor Ban-

croft removed the appendix on X-ray findings alone. But his 82 per cent. benefits may justify the procedure; he did not agree with Doctor Bancroft's removal of the appendix where there were no subjective or objective symptoms. Doctor Bancroft's operation is a choice one in that it puts the ulcer in an alkaline medium and gives a satisfactory closure of the pylorus, and has not the difficulties of attempting excision of the ulcer particularly when it is attached to the pancreas. He did only one gastroenterostomy! Surely gastroenterostomy still has its place in surgery of the duodenal ulcer, particularly in those ulcers of long standing with a large excess of hydrochloric acid and marked deformity of the cap producing obstruction. The Levine tube has often proved a life-saving measure; many secondary operations have been prevented by its use. The most important part of this team work is the assistance of the internist in establishing a long, careful, pre-operative preparation of the patient, his daily post-operative round and meticulous post-operative supervision.

Dr. Charles W. Lester (by invitation) said that operations on the appendix for the prophylaxis or treatment of post-pyloric ulcer are undertaken for the purpose of correcting pylorospasm. Pylorospasm is a persistent contraction of the pyloric muscle during a large part of each gastric cycle. The pyloric muscle is fan-shaped and embraces the pyloric region. During gastric peristalsis it is relaxed until the peristaltic wave reaches it. Then it contracts on the gastric contents in its embrace and forcibly squirts it into the duodenum. Thus it is not a true sphincter although it can have a sphincteric action. Its nerve supply is by a separate branch of the sympathetic.

Irritation anywhere in the peritoneal cavity can set up impulses along this sympathetic route which bring about a spasmodic contraction of the pyloric muscle and make the condition known as pylorospasm. The most frequent site of this irritation is in the region of the appendix. The appendix is usually found kinked by adhesions and these adhesions frequently involve the cæcum, terminal ileum and sometimes the ascending colon. Simple appendectomy in the presence of these adhesions will not suffice to remove the irritation. The adjacent gut must also be freed. Nor will all cases of pylorospasm be benefited by appendectomy. The cases must be selected with care on the basis of clinical and röntgenological evidence of trouble in the right lower quadrant. All the successful cases cited by Doctor Bancroft had this evidence which was verified by the operative findings. It is futile to remove the appendix when the source of irritation lies elsewhere in the peritoneal cavity.

Dr. Richard Lewisohn agreed with Doctor Bancroft as to the importance of a close coöperation between the internist, the radiologist and the surgeon. However, he thought that to put the question of operative indication on the radiological department meant a very heavy burden for the radiologist. While his opinion should carry a great deal of weight, the final decision must rest in the hands of the clinicians.

Doctor Bancroft stated that he had performed an appendectomy in eleven cases of duodenal ulcer without subjective or objective signs of appendicitis, purely on X-ray findings. The appendix was removed through a McBurney incision. Stomach and duodenum were not inspected or palpated. Doctor Lewisohn wondered whether any definite conclusions could be drawn from this series of cases. When a cure was effected, the possibility of an erroneous X-ray diagnosis would have to be considered. It would be reasonable to assume that the patient did not suffer from a duodenal ulcer, but from chronic appendicitis. Pylorospasm due to a diseased appendix is undoubtedly a very rare occurrence. It would require an observation time of at least five years to exclude the possibility that we were not dealing with a temporary improvement due to an intermission-period in the life cycle of a duodenal ulcer.

Doctor Bancroft has reported on twenty-one major gastric operations (two Billroth I, two Billroth II and seventeen Devine operations).

Doctor Lewisohn stated that he had no personal experience with Devine's gastric exclusion. The latter procedure does not differ considerably from Eiselsberg's "Exclusion zur Ausschaltung." In both operations the duodenal ulcer is left *in situ* and the acid figures are not reduced materially. Eiselsberg does not use his method any longer, as the incidence of recurrent gastrojejunal ulcers was very high. The late follow-up results following the Devine operation are not apt to be better than those following the Eiselsberg method. A simple side-tracking operation with resection of part of the stomach (Eiselsberg, Devine) rather than a Billroth I or II with removal of the ulcer, should never be the method of choice in gastroduodenal surgery. Even Finsterer's Resection zur Ausschaltung, which establishes a marked reduction in acidity, should be used only in non-resectable duodenal ulcers.

Doctor Bancroft reported an average of between 50 and 60 per cent. cures with different surgical procedures in the presence of a duodenal ulcer. These statistics, even in a follow-up of short duration, are not superior to those which had been reported by Doctor Lewisohn following gastroenterostomy. Furthermore, it is very possible that some of the cures are temporary and will not stand the test of a five-year follow-up (the usual minimum requirement as to end-results).

Dr. Frank S. Mathews said that he finds in this paper a number of viewpoints with which he cannot concur. It seems to him that the operating surgeon assumes a responsibility to a patient which he cannot delegate to members of a committee even though it is advisable for him to seek advice wherever he can get it. If Doctor Bancroft should operate on a patient with duodenal ulcer and explain afterward to the patient that the operation had been dictated by a physician and a radiologist on the basis of a previous agreement, neither in law nor morals could his position be defended. Surgery is a dignified profession and the patient can hold the surgeon directly responsible for the selection of operation and the type of operation per-

formed. Most surgeons become a little touchy if they find that their patients consider them at all as expert mechanics to be directed by some wise physician. In the cases reported a number of operative procedures have been employed, nearly all of which are operations of a greater magnitude than gastroenterostomy. Here Doctor Mathews seemed to see the influence on Doctor Bancroft's work of a radiologist who has been so outspoken in his condemnation of that operation. Doctor Mathews is perfectly convinced that gastroenterostomy is a valuable surgical operation. In 1931, Balfour and associates operated on 450 patients with duodenal ulcer and performed gastroenterostomy on 58 per cent. with less than 1 per cent. mortality. In 32 per cent. the ulcer was excised with a plastic on the pylorus. This leaves but 10 per cent. of the cases for resections and exclusions. Every month at his follow-up at St. Luke's Hospital Doctor Mathews has been impressed by the good results of gastroenterostomy in selected cases, as the patients come back year after year with scarcely any complaints. The results, he is confident, are due to the gastroenterostomy, although the radiologist referred to has asserted that ulcers heal in spite of it. Doctor Mathews sees no reason to replace the operation by more formidable ones in the average ulcer case requiring operation. He has done exclusions and resections in duodenal ulcer, but is strongly impressed with the extensive field of usefulness of gastroenterostomy in these cases. He believes the abolition of this operation from Doctor Bancroft's series further indicates that he has been ill-advised in sharing the responsibility for the selection with others who are not operating surgeons.

Dr. J. William Hinton said that in the Stomach Clinic at Bellevue Hospital they have had 460 cases in the past four years. Of that number 128 were post-operative cases. Of the 128 cases 59 per cent. have been operated on for acute and 69 per cent. for chronic ulcer. That leaves 332 unoperated cases of ulcer seen in that time. Of the 69 per cent. operated there are twelve with marginal ulcer, 16 per cent. of gastrojejunal ulcer, three of whom the speaker personally operated on. He had been very much surprised at these figures which convinced him that gastroenterostomy is not as ideal a procedure as he had thought it. Patients have come back seven years after gastroenterostomy. They felt fine at first but developed pain from jejunal ulcer. It has been proven by gastroenterological studies that many of the patients have been treated medically for years afterward. As to the follow-up, Doctor Hinton did not believe this was of any value unless the patients are seen personally.

Doctor Bancroft, in closing the discussion, said that he had expected there would be some criticism of the policy adopted. Nevertheless, he had felt that it was worth an experiment to attempt to improve the treatment of duodenal ulcer. If a marked advance could be made by a similar method in the treatment of diabetes, it could be achieved in ulcer. Therefore, as an experiment, it had been decided that the surgical department would, on the

recommendation of the internist, remove the appendix in cases of early ulcer or pylorospasm, without exploring the ulcer. He felt that the results had justified the experiment. The fact that a large percentage of the ulcer cases were free from symptoms on an unrestricted diet, and that there was only an 18 per cent. failure, he felt, justified the experiment. In pylorospasm the results, of course, had been better than in ulcer, as shown by the figures. The discussion of whether the internist and radiologist should dictate the policy in reality did not work out as didactically as one might assume from the plain statement. As a rule, in the discussions of the cases, it transpired that all three agreed on a given policy. This was largely due to the fact that the surgical department had no desire to operate on a large series of duodenal ulcers, but only to operate on the cases with a prolonged history and which were obvious medical failures.

The speaker did not agree with Doctor Lewisohn that subtotal gastrectomy is the operation of choice in the hands of the general surgeon. He felt that the mortality would be so great that the operation would not be justified. He also felt that in cases with a prolonged history and deep scarring a gastro-enterostomy has too many failures to justify its use.

Doctor Bancroft realizes that the series of cases presented is small and that a sufficient length of time for follow-up analysis has not elapsed to draw didactic conclusions. So far, however, the post-operative results of the Devine operation have been satisfactory.

STATED MEETING HELD APRIL 13, 1932

The President, Dr. John Douglas, in the Chair

LATERAL DISLOCATION OF THE KNEE-JOINT

Dr. John H. Garlock presented a man, forty-two years of age, who was admitted to the Second Surgical Division of the New York Hospital, November 8, 1930, with a history that a few minutes before, his right leg was caught between an elevator and the elevator shaft, and the knee severely twisted.

Examination showed there was a complete lateral dislocation of the knee-joint. (Fig. 1.) The lower end of the femur was displaced internally and the articulating surface could be felt beneath the skin. The upper end of the tibia was displaced externally, and its superior articulating surface could be easily palpated.

The patient was anæsthetized and the dislocation was reduced by a combination of traction, hyperextension, and counter-pressure on the tibia and femur in opposite directions. A posterior splint was applied. Active motion was instituted on the fifth post-operative day. At this time, 20° flexion in the knee-joint was already present. Active motion was then continued three times daily for a period of ten minutes. He was allowed out of bed on crutches on the twenty-third post-operative day. Physiotherapy was then instituted. A brace was obtained for him which he wore for a short while. It was felt that this support was indicated because of undoubted injury to the crucial ligaments.

His condition at the present time is as follows:

Extension is normal. Flexion proceeds through an arc of about 110°. There is no instability of the knee-joint in any direction. The patient gets about without the aid of any support, and there is no appreciable limp. He was presented because of the rarity of the injury and to call attention to the

FIG. 1.—Lateral dislocation of knee.

complete lack of instability in the knee-joint even after the severe trauma, which undoubtedly involved tearing of the crucial ligaments.

DR. JAMES M. HITZROT said that there are a number of operations that have been devised for the repair of tears of the crucial ligaments, but their

desirability as well as the results obtained are still under discussion. In Doctor Hitzrot's experience, by simple fixation stable knee-joints are obtained after dislocations in spite of the fact that the ligaments may be completely torn. In fractures in which the ligaments are involved, the coincident injury to one or the other of the intra-articular cartilages is the serious complicating factor.

Dr. Bradley L. Coley said that he had recently under his care a man with a lateral dislocation of the knee-joint. The leg was displaced laterally and there was complete tear of the internal lateral ligament. It was apparent from a study of the X-ray films that the crucial ligaments had been torn. The patient was brought to the hospital within an hour of the accident and the knee was immediately reduced and placed in plaster. The plaster was kept in place for four weeks and then removed. At this time there was no abnormal mobility of the knee in any direction. The man was able to walk and his convalescence continued satisfactorily. He is now back at work ten weeks from the date of the accident.

FRACTURE AT THE LOWER END OF THE TIBIA WITH MARKED DISPLACEMENT

TWO OPEN OPERATIONS. RESULT AFTER TWO AND A HALF YEARS

Doctor Garlock presented a man, fifty years of age, who, in September, 1929, was first seen nine weeks after he fractured his right ankle. After the accident, he was taken to a hospital in New York, where, without anæsthesia, a plaster case was applied. After two weeks he returned home.

Examination November 27, 1929, showed a marked deformity just above the right ankle due to a badly comminuted fracture of the lower end of the tibia with marked displacement of the fragments. Clinically, there was no evidence of union. December 2, 1929, the site of injury was exposed by a curved incision on the antero-medial aspect of the lower leg. There was no evidence of union. The distal fragment was markedly comminuted, but presented one large fragment anteriorly. The upper fragment was displaced inward and backward. The ankle-joint was visible in the field. At this time nothing was done to the fracture of the shaft of the fibula. The fragments were mobilized, and what was thought to be a satisfactory reduction was accomplished. A sliding bone inlay graft taken from the upper fragment was then placed across the line of fracture. The wound was closed after careful hemostasis and a circular plaster case applied from toes to mid-thigh. Post-operative X-ray examination revealed that a complete reduction had not been accomplished, and that a serviceable weight-bearing surface had not been produced. Therefore, a second operation was performed December 26, 1929. An external lateral incision was made over the site of the fracture of the fibula. Firm union was found at this point. The fracture was reproduced with a chisel and a mortise fashioned so as to obtain locking of the fragments. This was further reënforced by a kangaroo suture passed through drill holes. The scar of the first operation was excised and the fracture of the tibia again exposed. The bone graft was found firmly united. It was pried loose and preserved. All the tibial fragments were dissected free from the surrounding tissues and mobilized. Reduction was then easily accomplished, but difficult to maintain. It was found necessary to remove the

upper projection of the lower posterior fragment. The fracture was then reduced and the foot placed in inversion. The bone graft was placed in its original bed and the wound closed without drainage. A circular plaster case was then applied from toes to mid-thigh with the foot in inversion and dorsiflexion. The patient was discharged from the hospital January 7, 1930, after an uneventful convalescence. The plaster case was removed after two and one-half months and union was found to be firm. He received careful physiotherapy for three months, and began to bear weight on the extremity after four months. At the present time, there is about 30 to 40 per cent. impairment of motion in the ankle-joint. The patient has a good weight-bearing surface, and is able to carry on his activities without difficulty.

Doctor Hitzrot said that in treating these old fractures of the ankle-joint the liberation of both fragments is most important. He had shown before this society (Annals of Surgery, March, 1932) a case in which there was a fracture of the fibula with a posterior fragment broken off from the tibia and displaced posteriorly. The case was ten months old when he first saw it. After liberating both fragments, fibular and tibial, the dislocation of the foot was reduced, but in so doing the circulation of the foot was arrested and that procedure had to be given up. So he devised an operation by which he resected the lower end of the tibia, reconstructing the joint to bring it into the weight-bearing area. Four months after the operation the patient was able to walk on the foot and is now able to do almost anything with that foot, although he has some limitation of dorsal flexion. In another case, operated on previously by another surgeon who made two incisions, Doctor Hitzrot operated two years later because the woman was unable to walk on the foot without a special shoe. After the operation, she could wear a normal shoe. Unless all the fragments are liberated they cannot be gotten back into position. In the first case reported even this was unsuccessful but the operation devised at that time seems, after the lapse of four years, to have been successful.

NON-SPECIFIC GRANULOMA OF ILEUM. ILEOCECAL RESECTION. RESULT NINE YEARS AFTER OPERATION

Dr. Donald Gordon presented a woman, forty-nine years of age, who was admitted to Roosevelt Hospital April 19, 1923, for pain in the right side of the abdomen. She was fairly well until three years ago, when irregular attacks of pain in right side of the abdomen began. During one of these attacks she was operated upon for appendicitis. At the operation, the appendix was found to be normal, but it was removed, and at that time a thickening of the ileum and cæcum was noted, but on account of her condition, resection was considered too dangerous. She was better for a time after the operation, but gradually developed the old discomfort, which continued to grow worse until one and one-half years ago, when, after an acute attack of pain in the right lower quadrant, a mass remained in the right lower quadrant. This mass is very tender, and requires her to support it when she turns over in bed, and to protect it in every way. She has cut down on all food, until she is now taking only toast, tea, and milk. She has frequent attacks of nausea and occasional vomiting. Bowels move two to three times a day with Squibb's paraffin oil. Bowel movements of a diarrhœal

character, frequent, profuse, watery, no visible blood, and no tenesmus. She has lost sleep, weight, and strength on account of pain and lack of food. She is growing worse. Her abdomen is scaphoid except at right lower quadrant, where there is a pronounced palpable rounded mass size of an orange in right iliac fossa, slightly movable, hard, and tender at upper end beneath old appendix scar. Operated upon April 20, 1923. Right Kammerer incision eight inches long exposed a large mass in right iliac fossa attached to right side of parietal peritoneum, with great omentum adherent to mass. The ascending colon was angulated back on itself and attached to this mass, bringing the right end of transverse colon down to this position, forming a kink in ascending colon besides the obstruction at the ileocecal junction. The ileocecal mass was released with incision along right lumbar gutter and into mesentery of ileum. This was mobilized, side-to-side anastomosis isoperistaltic was done with linen for outer suture, and chromic catgut for inner suture. The ends had been crushed with clamp, cauterized, and inverted with purse-string of linen. The mesentery was ligated with plain catgut, and the peritoneal denudation covered with few plain catgut sutures. Peritoneum closed with No. 2 plain; rectus sutured with interrupted chromic catgut; skin with interrupted silkworm gut.

Post-operative Course.—Temperature rose to 102° on fourth day, then fell to the normal. Wound drain removed on eighth day. On the thirteenth day temperature started to rise and reached 103.6°. Coincident with temperature there was a marked and rather intractable diarrhœa, which was thought to be the cause of the temperature; but a mass developed in the right side of abdomen, which explained the temperature.

May 18, under local anæsthesia, the old incision was reopened down through the muscles, and a mass found to the right of intestines. This mass was above the old drainage. It was incised and about six ounces of creamy pus evacuated together with remnant of old fibrin of hematoma. Wound drained with three tubes for ten days. Irrigated daily.

After the evacuation of this secondary abscess, the temperature fell immediately to the normal, and remained so. The patient was discharged May 29 with granulating wound with small sinus from which there was a slight discharge. Weight, eighty-three pounds, feeling well, and eating everything.

Subsequent History.—Weight went up to 126 pounds and stayed there until a severe nervous strain one year ago resulted in loss of appetite and weight. Her weight went down to 105 pounds, at which point it has remained for a year. For one year after operation, she had seven to eight bowel movements a day. These gradually became less, and ceased upon changing from seven to eight glasses of water a day to a similar amount of milk.

Examination in March, 1932, shows a moderate hernia for which she does not wear any support. No masses, no tenderness. Patient is very active and has no complaints.

Pathological Report.—Macroscopical.—About two feet of intestine of which ten inches is small intestine and rest is large intestine covered with fibrous adhesions and raw edges. There is a tumor mass, seven by five by four centimetres, at the ileocecal junction which is bound down by surrounding adhesions and gives the appearance of beginning intussusception. The centre of the hardened specimen showed a lumen which would just accept a silver probe. The macroscopical slide shows increase of fibroblastic tissue with dilatation of blood-vessels. Few polymorphonuclears, many lymphocytes, and a moderate number of endothelial cells. No giant cells or true tubercles seen.

Diagnosis.—Chronic inflammation of ileocecal region with chronic intestinal obstruction.

Dr. John M. Hanford cited a similar case. The patient was a cardiac, a woman, about thirty years of age, but had compensation. She came to the hospital with acute ileus. At operation a large fusiform mass was found in the terminal ileum. This was resected and it was possible to make an end-to-end anastomosis very near the cæcum. Jejunostomy was done and the patient recovered. She still has attacks of abdominal cramp-like pain but on account of the bad cardiac condition no further operation has been advised.

The specimen removed showed thickening of the gut wall, narrowing of the lumen and ulceration of the mucosa. *Microscopically.*—The main findings were replacement of mucous membrane by granulation tissue, dense infiltration with mononuclear cells and tremendous dilatation of the lymph sinuses in the adjacent mesenteric lymph-nodes. Dr. A. P. Stout, the surgical pathologist, stated that it was an "entirely unexplained ulcerative lesion of the ileum."

Dr. Charles L. Janssen referred to a similar case. The patient was a young woman, twenty-one years of age, who had symptoms of acute appendicitis. Before coming to the hospital she had been ill about fourteen days with elevation of temperature and a mass in the right lower quadrant. Immediate operation was done and the cæcum and terminal ileum were found to be matted together. The appendix was removed with great difficulty on account of the thickening. The patient had a stormy convalescence and three days afterward developed a fecal fistula. Pathological examination showed a marked thickening of the wall of the appendix but no tubercles. That fecal fistula had developed raised the question of tuberculosis but examinations of the chest were negative. Examination of the cæcum showed some deformity. An attempt was made to close the fistula with a direct attempt on the cæcum. Two holes were found, and it was concluded that the fistula was the result of the breaking down of the cæcum through some inflammatory reaction. The patient leaked some fecal material after the operation and from time to time there has been some fecal discharge. As tuberculosis was ruled out it was thought a granuloma should be considered as a possible cause.

Dr. Carl Eggers said that he had operated on two patients who are difficult to classify and who probably belong to the group of non-specific granuloma of the intestines. Both presented large palpable tumors in the right lower abdomen which disappeared completely after an ileocolostomy followed by X-ray treatment.

The first patient, C. T., fifty-seven years of age, came under observation October 14, 1919, with symptoms suggestive of incomplete intestinal obstruction. An X-ray examination was not made at that time. Under medical treatment the symptoms improved and he was not seen again for several months. In February, 1920, he again complained of abdominal cramps and pain over the right lower quadrant associated with constipation and later diarrhœa. There was no vomiting and no blood was noted in the stool. There were no urinary symptoms. Röntgen-ray examination did not help in definitely establishing a diagnosis. The patient was anæmic and had lost weight. Abdominal examination showed a large, nodular tumor on the right side, tender to touch.

Operation, February 19, 1920.—Five-inch right rectus incision. No free fluid. A large tumor presented which fixed the cæcum and the ascending

colon in their position and extensively invaded the retroperitoneal lymph-nodes as well as the mesentery of the ileum. Whether the tumor arose in the wall of the gut with secondary lymph-node involvement, or whether it was a lymph-node tumor encroaching on the gut could not be determined. It impressed as an inoperable malignant tumor. An ileocolostomy was done after dividing the small gut about five inches from the ideocecal valve. The abdomen was closed without drainage.

The convalescence was uneventful. The wound healed by primary union, and all intestinal symptoms were relieved. He was given a series of X-ray treatments and after a short time the tumor mass disappeared entirely.

About two and a half years later a complete gastro-intestinal X-ray examination was made after a meal and a barium clysma. There was no sign of a tumor or a defect. The ileocolostomy functioned well.

Since then the patient has shown no symptoms in reference to his intestines.

The second case, H. F., sixty-four years of age, was admitted to the Lenox Hill Hospital, May 12, 1931, complaining of pain in the right lower abdomen for about a week. He was markedly constipated but had no symptoms of obstruction. He gave an interesting history of an attack of acute appendicitis thirty-five years before which had recurred about ten times and each time subsided with rest and the application of an ice-bag. Blood in the stools had been noted repeatedly. He had lost fifteen pounds in weight during the last year and during this period constipation had become more pronounced.

For a long time he had been an invalid; he had chronic myocarditis and about a year before admission had developed paralysis of the left arm and the left side of the face. He had a blood-pressure of 240 at that time. At present he was under constant medical care for his cardiac condition and blood-pressure of 200.

The local findings were as follows: Abdomen large, soft, and tympanitic. In the right lower quadrant of the abdomen a large, nodular mass, the size of a grapefruit, was palpable and tender to touch. It filled the iliac fossa and extended upward to two fingers above the umbilicus, mesially almost to the median line, downward to Poupart's ligament, and laterally to about two fingers beyond the anterior superior spine. The tumor was fixed in position but the abdominal wall was not adherent to it. There were apparently no obstructive symptoms or signs. The inguinal lymph-nodes were not enlarged, and no Virchow glands were palpable. He had several lipomata in the abdominal wall. The patient had a bilateral inguinal hernia and a right-sided hydrocele without any suspicion of malignancy. Rectal examination showed hæmorrhoids and a large soft prostate.

The general impression of the patient was quite good. The nature of the growth was doubtful. It was apparently a primary tumor originating in the right lower quadrant.

May 18, 1931, a five-inch right rectus incision was made. A large tumor was found to occupy the right iliac fossa, which extended down into the pelvis, displacing the iliac vessels. It was very large and immobile. It involved and projected into the cæcum and absolutely fixed that part of the gut, and it likewise involved the appendix, the lower ileum, and its mesentery. There was such extensive involvement of the lymph-nodes that it was impossible to say whether the growth originated in the gut with secondary lymph-node involvement or whether it was possibly a primary lymph-node tumor invading the cæcum. It felt somewhat cystic and gave rise to the impression that it might be a large mucocele starting from the appendix, or possibly a gelatinous

carcinoma. A biopsy could not be done without infecting the peritoneum. On account of its size and extensive attachments a radical operation seemed impossible, especially in view of the patient's cardiac condition. A decision was reached to do an ileocolostomy, to give the patient X-ray treatment, and later to attempt removal of the tumor if the condition warranted it.

The ileum was therefore divided about four inches from the ileocecal valve. Both ends were closed and the upper one then united to the middle of the transverse colon by a lateral anastomosis.

The convalescence was uneventful. The wound healed by primary union. A series of six X-ray treatments was given from June 4, 1931, to June 13, 1931. A second operation was then decided on for the purpose of removing the tumor.

June 17, 1931 (one month after the original procedure), under spinal anæsthesia, the old incision was reopened and extended downward for better exposure. Extensive adhesions were encountered and after they were separated it was found that the large tumor mass had almost completely disappeared. All that remained was a small infiltrated tumor mass plastered against the lateral pelvic wall. The land marks were ill defined. The lymph-node tumor had also practically disappeared. A resection was considered unwise as they were apparently dealing either with an inflammatory lesion, a granuloma of some form, or a very radio-sensitive border-line tumor.

The ascending colon and cæcum were found to be in a state of collapse. There was apparently no regurgitation of fæces into this excluded loop of gut and there was therefore no reason to believe that it would cause trouble later on. The abdomen was therefore closed without drainage.

As soon as the patient's condition permitted he was given another series of six X-ray treatments between July 7, 1931, and July 18, 1931. He was discharged completely relieved of abdominal symptoms and without any palpable tumor. He has subsequently received some more X-ray treatments.

In February, 1932, he was re-admitted on account of acute bronchitis, chronic myocarditis, and auricular fibrillation, which subsided under treatment. At that time no tumor was palpable, and a barium clysma showed good outline and normal function of the bowels.

At present he is in good condition.

Dr. Edward W. Peterson referred to a case he had shown before this society five years ago. In July, 1918, at an operation for the relief of hydrops of the gall-bladder, it was found that the patient was also suffering with tuberculosis involving the cæcum and appendix. As the peritonitis was thought to be of the peritoneal, rather than of the enteroperitoneal variety, nothing was done at the time except the removal of the appendix and gall-bladder. Seven months later the patient was operated upon by the late Doctor Silleck for partial intestinal obstruction. Massive infiltration of the cæcum and ascending colon gave the impression of inoperable malignancy, so Doctor Silleck closed the abdomen and ordered deep X-ray therapy. A later study of the previous record convinced him that he was dealing with an extensive hyperplastic tuberculosis and not with a malignant condition. Following intensive X-ray treatment the tumefaction in the right side of the abdomen disappeared and all abdominal symptoms were relieved. For over six years the patient considered himself perfectly well, but in July, 1925, he was again operated upon for partial intestinal obstruction. An exploratory operation revealed a small tumor obstruction at the ileocecal valve, numerous scars on the cæcum, ascending colon and mesentery, but there was disappearance of the massive hyperplastic tuberculosis encountered by Doctor

Silleck at the previous operation. A lateral anastomosis between ileum and transverse colon was made, further X-ray treatment was given, and again there was complete relief of all unpleasant symptoms and rapid gain in weight and strength. This lasted until 1931, when an intra-abdominal abscess developed in the right lower abdomen. This was opened up in another hospital by another surgeon. At the present time there is a persistent sinus leading down to the ileocecal region, and a large area of ulceration of the abdominal wall of the right lower quadrant, where the X-ray treatment had been given. This report is given in answer to Doctor Eggers' suggestion that a short-circuiting operation and X-ray therapy may prove satisfactory in granuloma or tuberculosis of the cæcum. Doctor Peterson regretted that in his case radical treatment was not carried out, instead of the conservative measures mentioned.

DERMOID CYST OF MEDIASTINUM

Dr. Carl Eggers presented a woman, thirty-seven years of age, who was referred for treatment March 14, 1932, with the diagnosis of dermoid cyst of the mediastinum, which had been definitely established by her consulting physician on the basis of Röntgen-ray examinations and an exploratory puncture. Her chief complaint was dyspnœa and cough. She had not been well since June, 1930. At that time, without any premonitory symptoms, and without any warning, she suddenly had an attack of dizziness, faintness, and a feeling of compression within the chest. She was hardly able to breathe or move. There was no real pain, but a peculiar feeling of pressure and oppression which made her fearful that something might happen. She did not faint, and did not cough, and there was no expectoration. Her physician was unable to make a diagnosis and is said to have kept her intermittently under chloroform for about twelve hours. There was gradual improvement but she did not completely recover and a few weeks later consulted another doctor who diagnosed pleural effusion and aspirated it, with considerable relief to the patient. The fluid was clear and negative on culture. An X-ray of the chest was not done at that time.

The patient was seen again by this doctor in October, 1930, and he reports as follows: "An X-ray of the chest showed a curious, evenly outlined right hilus shadow with dullness on percussion. This shadow was so sharp and directly opposite the pericardium that a fluoroscopy was done, and it was definitely established that the heart, pericardium and œsophagus were not concerned. She had no symptoms and has had no symptoms except a slight discomfort on deep breathing. Several subsequent X-ray examinations have been made. The shadow and area of dullness have increased in size during the last year, and the outline has become more circumscribed. A diagnosis of mediastinal cyst was made. Recently, the patient, who is in excellent health otherwise, suffered some slight increase in dyspnœa on exertion and some feeling of chest pressure. On February 11, 1932, a paracentesis was done of the cyst itself with a very long needle, removing about ninety cubic centimetres of typical dermoid material. Since then the patient has been very comfortable and goes about doing practically everything which does not involve too much exertion. However, a radiograph taken yesterday convinced me quite definitely that the time has arrived for action."

Her doctor further reported that he had first seen the patient in consultation in August, 1928. Her chief complaint at that time had been stiffness and swelling of the neck, particularly on the right side, which had been preceded by pain in the right arm and shoulder. She also complained of tightness in the throat and difficulty in swallowing. He subjected her to a

very careful physical examination at that time, including an X-ray study of the chest. Nothing was found which apparently had any relation to the later diagnosis of mediastinal cyst. His only definite finding was an impacted right upper molar. After its removal all symptoms promptly disappeared.

When seen by Doctor Eggers March 14, 1932, her general impression was good. There was moderate dyspnœa, even on slight exertion. The general examination was negative.

The lower part of the neck looked widened and full, but nothing abnormal could be palpated. The thyroid was not enlarged.

Over the upper anterior chest there were numerous dilated superficial

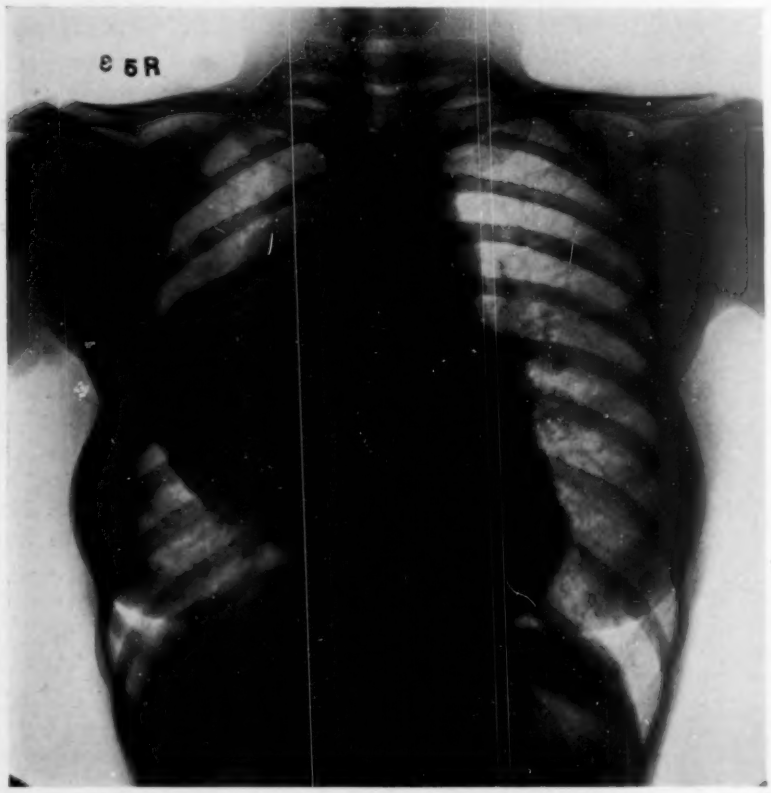

FIG. 2.—Mediastinal dermoid cyst, capacity 1,000 cubic centimetres, before operation.

veins which extended laterally from the upper sternal region over both sides. On inspiration there was marked retardation noted over the right side.

Posteriorly nothing abnormal could be made out, while anteriorly there was flatness on the right side, extending from the second rib downward to the diaphragm. It extended beyond the median line on the left and to the anterior axillary line on the right. Breath sounds were present over the entire area, however, and seem quite normal.

The heart sounds were slow, regular, good force, 90 per minute.

As soon as the patient lay down her face and neck became acutely red and swollen, and her eyes bulged and began to water.

The impression one got is that there was pressure on the large vessels, rather than on the trachea. As soon as she sat up the condition readjusted itself.

An X-ray examination showed a large cone-shaped shadow in the right chest, with its base in the mediastinum and its tip almost in the axillary line. The margins were smooth and sharply defined. (Fig. 2.) Operation March 17, 1932. Under local ½ per cent. novocaine anæsthesia a slightly curved incision was made over the right anterior chest with the convexity towards the left. It extended from the second to the fifth ribs about at the junction of the ribs with their cartilages. The breast and pectoral muscles were displaced outward. About four to five centimetres of the third, fourth, and fifth ribs were removed just distal to the junction with the cartilages. The intercostal tissues were dissected back, and immediately underneath was felt a large, tense mass. The exact location of the pleural reflection could not be determined. An exploratory puncture was done and light brown, thick, non-odorous fluid aspirated. A large trocar was then inserted and about 1,000 cubic centimetres of this same type of fluid and cheesy material removed by suction. (Reported negative for organisms and pus-cells.) The patient immediately experienced great relief.

After evacuation the cyst-wall collapsed somewhat and further exploration was possible. The pleura was found to be densely adherent to the outer side of the sac, but nevertheless the condition looked rather promising for complete extirpation in one stage. In attempting to shell out the sac the pleura was entered in several places, but apparently there was no free pleural cavity but only smaller pockets separated by adhesions. As a result of this the lung did not collapse and the patient had no distress. It was possible to completely separate the lung from the mass. In the other directions the separation was more difficult. In order to be able to proceed cautiously the sac was opened and dried with sponges. It was enormously large. Towards the left and in an upward direction it was impossible to palpate its limits; it reached beyond the median line into the left chest. Part of the lining was quite smooth, while other portions were thick, knob-like masses of skin, with a pigskin appearance, from which hairs grew, of which none seemed more than about an inch in length. With one finger in the sac acting as a guide, a further attempt was made to free the sac, but it was very difficult, especially opposite the thick, knob-like portions. The third and fourth costal cartilages were now completely removed, but even then much of the dissection had to be done without the aid of vision, especially under the sternum and in an upward direction. The strain was beginning to tell on the patient, but her color was good and she was cheerful. It was considered inadvisable to attempt complete extirpation in one sitting. There was danger of severe hæmorrhage. Marsupialization was decided on. Sac therefore freed somewhat more in all directions until it was possible to draw its opening well out of the chest. While freeing it from the pericardium in the depth the right phrenic nerve was divided. A gauze tampon was now packed into the sac and the edges were then sutured to the margins of the skin at the site of the third and fourth costal cartilages, close to the sternum. A large piece of rubber dam was inserted between the outer wall of the sac and the right parietal pleura. The rest of the wound was then closed with interrupted silk sutures.

The convalescence was uneventful except for a rise of temperature to 103° on the second night. There was at the same time considerable cough and pressure sensation in the chest. It was promptly relieved by removing the large gauze packing from the cyst which had become saturated with secretion and by its weight produced symptoms of pressure. The patient was

turned on her abdomen several times and in that position completely drained the cyst with relief of symptoms.

She was allowed out of bed on the tenth day and her progress had been uninterrupted, until she was completely free of symptoms. At the completion of the operation it was expected to follow with a second stage in about two weeks, even though the difficulties connected with the extirpation of the sac were known. However, several points of interest had been noted which made him hesitate. The sac had shrunken to such a degree that it was now possible to feel its limits in all directions. The secretion had markedly diminished. The pathological examination of part of the excised wall of the sac had

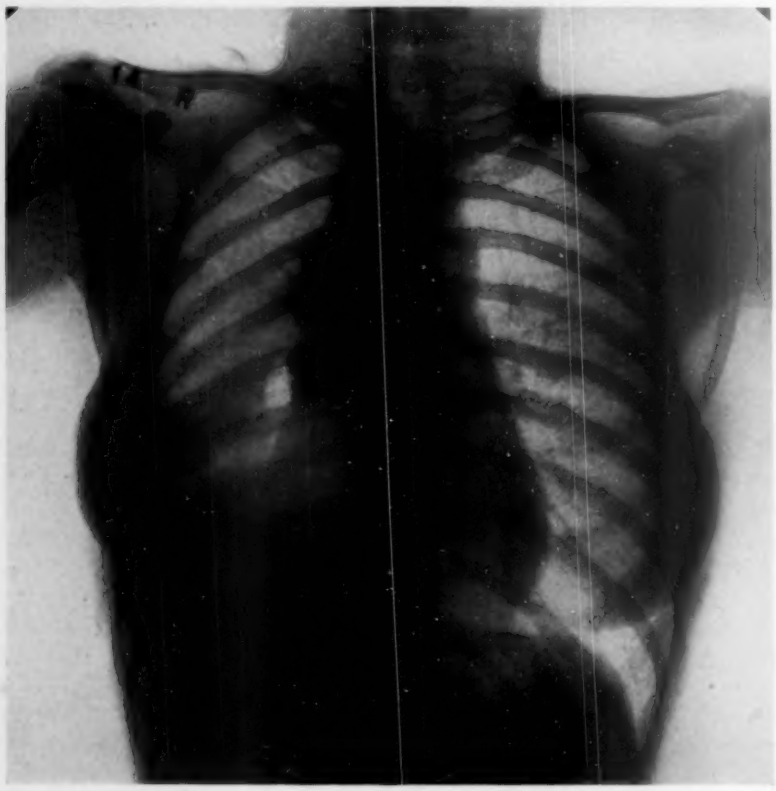

FIG. 3.—Mediastinal dermoid cyst twenty-five days after operation. Capacity thirty cubic centimetres.

shown that it was devoid of distinctive lining membrane, though in other parts there was thick skin with hair. This awakened feeling that there was reason to hope for considerable more contraction of the sac until only that portion remained which had a definite epithelial lining. It might be possible to later destroy that with an electric cautery. At present he was waiting to see what nature would do.

Injection of the remaining cavity three weeks after operation showed that it held only about thirty cubic centimetres. (Fig. 3.) An X-ray taken at that time demonstrated this small residual cavity.

DR. ALLEN O. WHIPPLE said that about two years ago he had a patient at the Presbyterian Hospital on whom he operated for a cyst in the right

side, thought to be a dermoid cyst of the mediastinum or pleura, that gave remarkable findings. She had suffered from the lesion for over twelve years and had had repeated tappings. Her chief symptom was dyspnœa, so severe that she could not lie down, but the tappings relieved this. Because of the necessity for repeated tappings it was decided to do an exploratory thoracotomy. On reaching the main cavity, peculiar knob-like thickenings were seen on the floor of the cyst. One of these was removed and was found to communicate with other cysts. Because the patient's condition was not good, further measures had to be stopped, only marsupialization being done. The patient developed a massive lung collapse on the other side and died from pneumonia. Autopsy showed the cyst was an echinococcus cyst, not a congenital one, of the pleura.

Doctor Eggers rejoined that one of the interesting points in the history of his patient was the acute onset with a feeling of pressure within the chest and dyspnœa so severe as to require the administration of chloroform. This point, together with the pathological examination of a part of the wall of the sac which was devoid of a definite epithelial lining, and the further fact that the capacity of the sac had diminished from 1,000 cubic centimetres to thirty cubic centimetres in three weeks, seemed very significant. He wondered whether the original dermoid cyst could have ruptured spontaneously and in addition to the primary tumor have developed a large secondary sac. This explanation seemed to him the most likely, as one would hardly expect as rapid a diminution in size of a tumor completely lined with epithelium.

HYDRONEPHROSIS AND MEGALO-URETER

Dr. Carl Eggers presented a young man, twenty-two years of age, who came under surgical care at the Lenox Hill Hospital February 26, 1931, complaining of attacks of pain in the left side of the abdomen for twelve years. He stated that he had been sick practically all his life. As a small child his tonsils were a constant source of trouble until they were removed. About twelve years ago he had first attack of pain in the left flank. It was sufficiently severe to cause him to hold his side and to double over. It did not radiate. There were no definite urinary or intestinal symptoms. The pain was constant and lasted about three days. Following this original attack he had others at the rate of about one every six months. For several years there was complete relief, but about six months ago the attacks came on again, at the rate of about every two weeks. Some lasted about twenty-four hours, while the last one, a week before admission, continued for three days. His only symptom in addition to pain was occasional urgency.

There was nothing in his personal habits to indicate relation to his symptoms and the only point of interest in the family history was the diagnosis of kidney and bladder stones in the mother.

On examination there was tenderness in the left costovertebral angle and on bimanual examination a large mass was palpable in the kidney region, extending down to the crest of the ilium. There was no muscular rigidity, but considerable tenderness over the mass and also along the course of the ureter. The right kidney was palpable but not tender.

Rectal examination revealed a small prostate. There was no tenderness on the right side, but on the left side, corresponding to the region of the entrance of the left ureter, there was infiltration and tenderness. The external genitals were normal. The urine was slightly cloudy.

A few days' observation, associated with urine examinations, repeated cystoscopies and X-ray examinations brought out the following points: The urine at times was clear, then again cloudy. There was no fever. The large mass in the kidney region completely disappeared with relief of pain. Cystoscopy showed a normal bladder and both ureters were easily catheterized. On the right side clear urine was obtained, indigo-carmine in good concen-

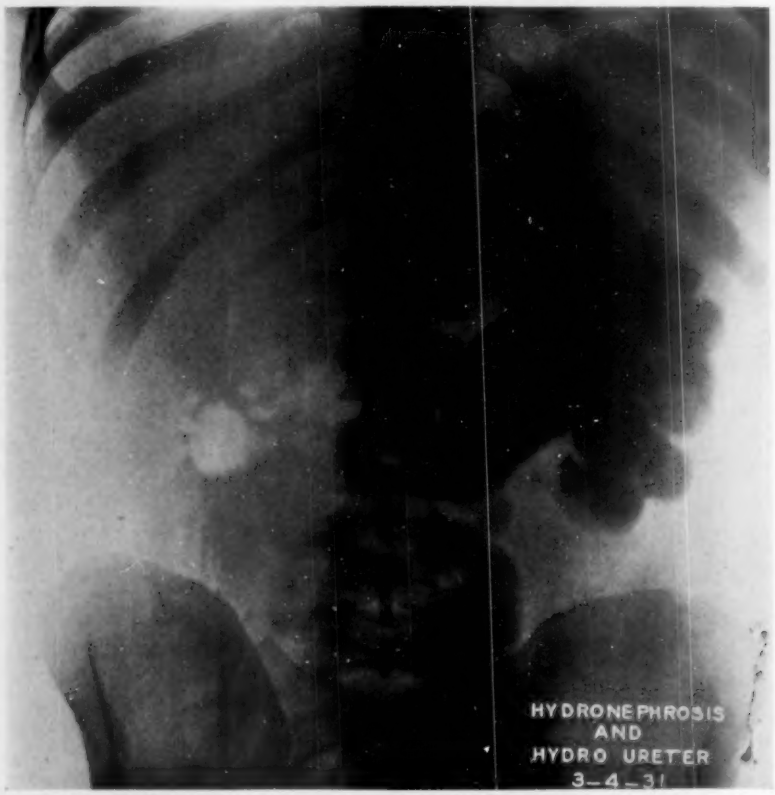

FIG. 4.—Hydronephrosis and hydro-ureter injected with sodium-iodide solution.

tration was received in five minutes. On the left side slightly turbid urine was collected but no indigo-carmine was excreted. A pyelogram done on the left side by blocking the ureteric orifice and injecting twenty cubic centimetres sodium iodide showed a pouch-like area size of a hen's egg just above the bladder, while the kidney and ureter were not outlined.

These various findings pointed to an old, rather quiescent suppurative lesion of the left kidney and ureter, probably not tuberculous in nature. The large mass which was felt on the original examination must probably be considered a hydronephrosis. A cystoscopy was therefore repeated for the purpose of filling and outlining the suspected sac. About 300 cubic centimetres sodium iodide were injected into the left ureter without causing any discomfort and the accompanying picture obtained. (Fig. 4.) There was present evidently

a hydronephrosis and a megalo-ureter. The etiology of the condition could not be determined.

In order to establish permanent drainage of the hydronephrosis and to overcome the existing infection of *Staphylococcus albus*, a catheter was inserted into the left ureter and allowed to drain continuously. At intervals the hydronephrotic sac was irrigated and collene then injected. This was continued for four days. Reconsideration of the case, and the realization that we were dealing with a large potentially infected sac with no kidney function, which represented a menace to the future welfare of the patient, made us decide in favor of extirpation of the whole mass, which was done March 18, 1931, through a left Langerbeck incision.

The hydronephrotic sac was gradually drawn out of the wound without resecting the twelfth rib. It was very adherent. After freeing it completely the vessels of the pedicle were doubly ligated and divided. A greatly dilated pelvis of the kidney and upper end of the ureter were freed and dissected downward. While doing so the ureter tore off about five inches below the pelvis, and was ligated at this point. A complete ureterectomy was not possible through the kidney incision. A cigarette drain was therefore inserted into the upper wound and the layers of the abdominal wall were closed around it. The patient was then turned on his back and a median suprapubic incision made. The bladder was freed extraperitoneally and the ureter isolated. It was much dilated. It was followed upward and when the stump was freed it was drawn down. By gentle traction and blunt dissection the ureter could be followed completely down to the bladder. It was then found that the lowest inch was only slightly dilated. No stricture or other abnormality could be made out and there was no aberrant vessel producing angulation or pressure. It was ligated with chromic catgut close to the bladder and the stump cauterized. One cigarette drain was inserted into the pelvis and the wound closed around it.

On the following evening the temperature rose to 103°, but on the sixth day it had reached normal and remained there. The convalescence was uneventful, and the patient was discharged cured on the thirty-second day. He has had no trouble since.

The specimen was constructed after operation by suturing the divided ureter and it was then filled with fluid in order to be hardened. It took almost 1,000 cubic centimetres to fully distend it.

Dr. Edwin Beer said that the interest of this case lies in the pathology from the surgical standpoint. When one encounters an enormous ureter of this sort with no pathological condition at operation to explain it, one is liable to regard it as a congenital megalo-hydronephrosis. In the speaker's opinion, causes may have existed in earlier life which led to enormous distention of ureter and kidney, which have disappeared at the time of operation, and the most likely would be a stone in infant life or during early childhood. As far as operation is concerned, Doctor Beer believes that total aseptic nephro-ureterectomy without opening the urinary channels should be done more often than it is. He has had forty cases on his service at Mount Sinai Hospital with no mortality.

HYPERTROPHY OF THE PYLORUS WITH ULCER OF THE STOMACH

Dr. William Barclay Parsons, Jr., presented a man, fifty-eight years old, who came to the hospital in November, 1931, complaining of recurring

epigastric pain. Two years ago he began to complain of epigastric pain coming on at irregular intervals from two to four hours after meals.

Under treatment he was relieved and his health had been excellent until three weeks prior to the present admission. At this time he again noticed pain occurring two to four hours after eating. The pain was located in the epigastrium, radiating to both the right and left and, at the few times when very severe, to the interscapular region. There was neither nausea nor vomiting at first. Eructations helped slightly, and soda gave distinct relief. His intermittent pain is usually at night.

The gastro-intestinal X-ray showed normal tone and peristalsis of the stomach, but a constant filling defect involving the lesser curvature portion of the pre-pyloric zone. He had no anæmia. Blood Wassermann was negative. The stools were negative for blood. His appetite was excellent, and his history of pain with relief by soda and prompt subsidence of symptoms with alkalies and diet was certainly more in favor of ulcer than carcinoma.

At operation the following pathology was found: The stomach was small, flexible. Just proximal to the pylorus, on the lesser curvature side, was a lesion roughly two and one-half centimetres in diameter. The overlying peritoneum was puckered. The mass was irregular, and it was doubtful whether it represented a small carcinoma or merely the thickening of an ulcer with a crater and irregular margins. No enlarged glands were found.

A partial gastrectomy was done. The crushing clamps were applied at a convenient point above the incisura, the stomach immediately distal to the clamps being soft and flexible, apparently the entire pathological region being just pre-pyloric.

Pathological Findings.—Gross.—The specimen consisted of a segment of stomach which measured six centimetres along the lesser curvature and thirteen along the greater. At the distal end there was palpable in the wall a distinct thickening which came within about three milligrams of the cut end. This was most marked on the anterior surface but also extended along the greater curvature, and up the posterior aspect. It was about two centimetres broad. The peritoneum over it was not stippled.

On section this thickening apparently consisted of a very marked hypertrophy of the musculature above which the mucosa and submucosa were distinctly outlined and were apparently free from tumor or ulcer. One centimetre from the proximal end of the stomach on the lesser curvature there was a punched-out ulcer with rolled edges, one centimetre in length and eight milligrams in breadth. It was oval with the long axis along the lesser curvature. On section this ulceration was found to interrupt the muscular coat but there was no marked thickening of the ulcer edges. It did not look neoplastic grossly.

Two small, soft, lymph-nodes about three milligrams in diameter were found in the omentum on the lesser curvature and one five milligrams in diameter on the greater curvature. This was partly replaced by fat.

Microscopical.—Section through the ulcer showed that the ulcer bed was covered with slough and that it rested upon a mass of scar tissue which completely erupted the muscular coat and extended out into the subserous layer. Caught in this scar tissue were a number of nerve bundles which were surrounded by thick-layered fibrous tissue. In the ulcer bed immediately beneath the necrotic tissue were many capillaries which came close to the surface. The scar tissue was infiltrated with great numbers of eosinophilic leucocytes. The mucous membrane at the margins of the ulcer was exceedingly vascular and showed distortion of the glands with some hyperplasia. A few of the glands were dilated and formed tiny cysts.

Sections through the pylorus showed a tremendous thickening of the pyloric muscle which was 1.3 centimetres at its thickest point and one centimetre wide. The mucous

membrane covering was intact and toward the stomach side was infiltrated with eosinophilic leucocytes and large cells with small nuclei and large, rounded, acidophilic masses in the cytoplasm. These might be plasmocytes. There was no evidence of cancer either here, in the region of the ulcer, or in the region of the lymph-glands.

Diagnosis.—Ulcer of stomach. Hypertrophy of pylorus of stomach.

The points of interest in this case are: First, the history was unquestionably due to the ulcer, and the thickening of the pylorus was in all probability not associated with any symptoms, although giving a filling defect on X-ray examination, suggesting pre-pyloric carcinoma. Second, the ulcer was not shown radiographically, and was not appreciable by inspection or palpation of the stomach, and was found only by the good fortune in having placed the clamps above it. This point emphasizes the importance of opening the stomach and inspecting the mucosa in cases of suspected ulcer where palpation has not convinced the surgeon of the presence of an ulcer.

THYROGLOSSAL FISTULA WITH SUBMENTAL OPENING

Dr. William Barclay Parsons, Jr., presented a man, twenty-seven years of age who came to the hospital because of a draining sinus in the neck which had been present for twenty-five years. This sinus was situated in the mid-line half way from the hyoid bone to the point of the chin in the submaxillary region, and had always discharged clear white fluid. There had been no pain, and nothing seemed to affect the amount of discharge except for brief periods when a crust would form. Except for a twelve-year history of chronic otitis media on the left, associated with a mastoidectomy, the previous health was quite unimportant. The Wassermann reaction was negative. Ear examination showed purulent discharge with an absent drum membrane. The oro-pharynx was congested. Tonsils were of moderate size.

Injection of the tract with lipiodol showed the tract running from the submaxillary region back to the hyoid bone and from there in general upward towards the foramen cæcum, with several small branching processes just above the hyoid bone. This demonstrated quite definitely that the condition was a thyroglossal fistula with an unusual level for the anterior opening.

The operation, as performed, was the typical one described by Sistrunk. The tract was cored out to the hyoid bone, a section of which was then removed. The tongue tract was then similarly cored out. One of the branches of the tract was seen before being divided, as it had been injected with methylene blue. This tract led directly backward just above the hyoid bone to the anterior pharyngeal wall. This was divided at the mucous membrane and was inverted beneath a purse-string suture of fine silk. The terminal portion of the duct was clamped and coagulated with a coagulating current.

The microscopical report was as follows:

"The section of the tract near the skin surface shows that it is lined with stratified cuboidal and cylindrical, ciliated epithelium. Some of the cells have vacuoles in them containing mucin. The tract in this portion is surrounded by a thick layer of dense fibrous tissue outside of which is striated muscle and fat. A section of the tract near the hyoid bone shows that it is lined with cuboidal epithelial cells without recognizable cilia but with occasional droplets of mucin. In this region there are many short, accessory branches which are found in the surrounding fibrous tissue. Together with these are some acini with colloid-like material in them, which are probably accessory thyroid acini. Another section near the hyoid shows two other fistulous tracts lined with stratified cylindrical ciliated epithelium and surrounded by striated muscles. *Diagnosis.*—Thyroglossal fistula."

TUMORS OF THE SMALL INTESTINE

Dr. Henry W. Cave read a paper with the above title for which see Annals, August, 1932, p. 269. The reading of the paper was prefaced by the presentation of two patients:

Case I.—A man forty-one years of age, was admitted to the Leroy Sanitarium March 25, 1931, complaining of weakness following collapse after a severe intestinal hæmorrhage.

For the past three years the man has had an indefinite pain in the abdomen, irregularity of bowel movements and considerable flatus. Appendix was removed some years ago. Two years previously had been treated for colitis. In February, 1929, a gastro-intestinal series was done which proved to be negative. The gall-bladder visualization at the same time showed the gall-bladder to be apparently normal.

His present illness began in the late afternoon of March 25, 1931, when, while preaching a Lenten service, he suddenly collapsed and was unconscious for a few minutes. He was taken to his home and then to a sanitarium. After arrival at the sanitarium he had a large bowel movement in the evening which without question contained a considerable amount of old blood, a copious, dark, tarry stool.

His hæmoglobin was 45 per cent.; Red blood-cells, 2,250,000. The following day he had a transfusion. During the next month he had several very large hæmorrhages while he was in the hospital. Numerous complete gastro-intestinal series were taken, all of which proved to be negative, until, on May 8, 1931, the röntgenologist reported a constant small diverticulum of the third portion of the duodenum. He also states that this was not noted on the plates taken a month previously, but a review of these former plates in light of this finding showed an instance of its presence. He goes further to state that this diverticulum has become larger in the past few weeks and might be a perforating ulcer of the third portion of the duodenum.

Pre-operative Diagnosis.—Bleeding diverticulum of the third portion of the duodenum. Diagnosis at operation.—Tumor of the jejunum approximately ten inches from the duodeno-jejunal junction.

Procedure.—Resection. Side-to-side anastomosis.

Pathological Report.—Leiomyoma of the jejunum.

This case was presented as one with unusually severe hæmorrhages from a tumor of the jejunum, to emphasize that early exploratory celiotomy is justifiable in indeterminate intestinal hæmorrhages.

Case II.—A woman, forty-five years of age, entered Roosevelt Hospital October 16, 1927, complaining of pain in the right upper quadrant of the abdomen. Her present illness began about one year ago with a vague feeling of depression and also distress in the right upper quadrant of the abdomen. Particularly has this discomfort been aggravated after eating of meat. Aside from these symptoms and a few vague aches and pains in the back, her present illness has been unimportant. Except for a tenderness in the upper abdomen just to the right of the mid-line in the epigastrium her physical examination was entirely negative.

X-rays.—Her gall-bladder showed a very faintly visualized, small, contracted gall-bladder with a poor concentration of dye; no stones identified. It was set down that failure to concentrate was due to a functional or some inflammatory mucosal changes; the dye test was considered only suggestive. However, a pre-operative diagnosis of chronic cholecystitis was made.

Operation.—Revealed a grayish-colored, distended gall-bladder which did not empty readily. It was the shape almost of a dumb-bell with a constriction or neck at the junction of the middle and lower third; there were no stones. Cholecystectomy was done.

On examining the duodenum there was found to be present a small tumor one centimetre distal to the pyloric vein and lying in the anterior wall of the intestine. It was small, approximately one centimetre by one centimetre, rounded, surface roughened, no crater distinguished; the tumor mass seemed to extend throughout the entire thickness of the intestinal wall. It was excised.

Microscopical section of this tumor showed normal mucous membrane, the interlacing bundles of smooth muscle being separated in places by masses of epithelial cells. These epithelial cells are arranged in solid masses supported by delicate tissue stroma and duct-like structures having a fibrous sheath. The individual cells have a uniformity in size, shape and staining properties. Some of the cells are arranged so that they resemble islands of Langerhans.

Diagnosis.—Accessory pancreatic tissue in duodenum.

This patient was shown on account of the symptom of increased epigastric distress while eating meat from which she has been entirely cured since her operation in October, 1927, a period of over four years; and also for the reason that perhaps the removal of her gall-bladder alone might have cured her of her complaint. It would be difficult to tell which condition was causing her discomfort.

It is stated by a physiologist that meat when eaten causes a more rapid secretion of pancreatic juice than either milk or bread. Therefore, in this case a distention of the pancreatic tissue confined within the wall of the duodenum may have been the source of her complaint. However, it is my own opinion that her gall-bladder was the inciting cause of her symptoms.

Dr. John McCreery said that of the disease, presented by Doctor Cave, in Bellevue Hospital there have been only seven cases in 160,000 admissions. Two years ago McWhorter and McCloud studied a series of 13,000 autopsies and found only six cases, three carcinomas and three sarcomas. The interesting point brought out in this study was that metastasis in the carcinomas was very slow, so that if early diagnosis were possible, operation might be expected to have favorable results. On the other hand, the cases of sarcoma metastasized very rapidly and widely spread. As far as diagnosis is concerned, an early one was made rarely. Early diagnosis depends on accident, such as intussusception or volvulus. He showed photographs of three cases of carcinoma. The first was a man who gave no symptoms until two weeks before his admission to the hospital. The second case, a lipoma, had a long previous history of pain due to attacks of mild intussusception. The X-rays had been unsatisfactory in all the cases.

TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY

STATED MEETING HELD MARCH 7, 1932

The Vice-President, Dr. Walter E. Lee, in the Chair

Dr. Calvin M. Smyth, Jr., Recorder

RETROPERITONEAL SARCOMA

Drs. E. L. Eliason and L. K. Ferguson presented a woman, aged thirty-eight years, who was admitted to the Medical Service of Dr. Alfred Stengel, October 10, 1927. She complained of epigastric distention, belching and indigestion, associated with a throbbing over the epigastrium. Eight months before admission the patient noted an egg-sized mass in the abdomen at the level of the umbilicus. The mass gradually increased in size. For the month preceding admission she had a marked gastric distention immediately after taking any sort of food. There was an associated pain in the upper abdomen unrelieved by soda which gradually disappeared after epigastric massage. Her appetite was good. After each meal defecation was necessary. Her stools were soft or semi-liquid but did not contain blood. She noted in addition an increasing œdema of the ankles, and slight frequency of urination with noctura two to four times. There was no loss of weight, her average being 134 pounds. She weighed on admission 137 pounds. Her past medical history was not significant. An interval appendectomy was performed five years before admission. There was a systolic murmur at the base of the heart. In the left epigastrium was a firm, round mass measuring eight inches in diameter. The mass was freely movable in the abdomen and the skin moved over it. It seemed to extend somewhat under the left costal margin.

The routine examinations of the blood and urine were within normal limits as were the various blood-chemistry determinations. X-ray examinations of the gastro-intestinal and urinary tracts showed no significant abnormalities except for a deformity of the greater curvature of the stomach, and a suggestive outline suggesting a tumor which was disclosed by a barium enema.

She was readmitted December 1, 1927, to the surgical service of Doctor Eliason. Since her previous admission she had had frequent attacks of vomiting after eating and had developed a backache in the lumbar region. At operation December 2 a mass about seven inches in diameter was exposed. It was round, fairly firm, smooth and covered by the anterior layer of the transverse mesocolon. Many large veins surrounded it. After dividing the anterior mesocolon, a friable tumor was exposed which bled freely. The mass was carefully freed from the anterior and posterior layers of the mesentery. Removal of the tumor showed clearly its location between the layers of the transverse mesocolon. It was well encapsulated and apparently entirely removed. It was pronounced by the pathologist to be a spindle-cell sarcoma. The post-operative course was uneventful. She was discharged fifteen days after operation.

Examination December, 1931, showed the abdominal wound well healed; no symptoms; no abdominal masses palpable.

SPLENECTOMY FOR SICKLE-CELL ANÆMIA

Dr. Fredrick A. Bothe reported the case of a colored boy, two years and ten months of age, who was admitted to the Children's Hospital April 3, 1930, with the

statement that the child had cried considerably for the past five months, was very restless, and had had repeated attacks of fever. These attacks occurred every five to ten days and lasted twenty-four to forty-eight hours. He had also suffered from frequent colds. When admitted his temperature was 101°; pulse, 140. He was very fretful and restless. There was definite evidence of rickets, but the abdomen was distended out of proportion to the other rachitic findings. The spleen was greatly enlarged. It extended to the umbilicus on the medial side and down to the crest of the ileum. A blood count revealed a hæmoglobin of 18 per cent.; red blood-cells, 1,000,000, and white blood-cells, 36,000; neutrophiles, 21 per cent.; lymphocytes, 70 per cent.; large mononuclears, 2 per cent.; transitionals, 2 per cent.; eosinophiles, 6 per cent.; basophiles, 1 per cent.; poikilocytosis was slight; achromia marked; megoblasts, 1 to 7 per 100 leucocytes; normoblasts, 5 per 100 leucocytes. The red blood-cells were positive for sickle-cell formation in an anaërobic preparation. The blood of the child's father, mother, and sister was also positive for sickle-cell formation. He remained in the hospital for five months, receiving repeated blood transfusions. During the early part of hospitalization the attacks of fever occurred every five to ten days and would last six to eight days. As his condition improved the attacks became of shorter duration and the interval between attacks was longer. He was discharged from the hospital September 8, 1930. At this time the hæmoglobin was 45 per cent.; red blood-cells, 3,880,000, and white blood-cells, 24,000. Thirteen days after discharge he was readmitted with a high fever and a recurrence of former symptoms. In addition, the child was suffering from a bloody diarrhœa and pain in the right elbow. No bloody stools were found after admission to the hospital, and the pain in the elbow disappeared in forty-eight hours. The hæmoglobin had fallen to 27 per cent., and the red blood-cells to 2,150,000. The fever persisted for three weeks. Again repeated blood transfusions were resorted to in an effort to overcome the severe anæmia. Eight weeks later the symptoms noted above recurred and in addition pains in the legs and an occasional pain in the abdomen developed. As the symptoms were becoming more pronounced and additional symptoms appeared a splenectomy was done March 27, 1931. The spleen was easily mobilized and delivered. Many enlarged nodes, probably hæmolymph-nodes, were found in the pedicle. The spleen weighed 295 grams. Microscopical studies showed the pathological changes characteristic of the spleen in sickle-cell anæmia. There was a fair degree of fibrosis and an occasional giant cell was found. Within the giant cells, elongated bodies are seen which Jaffe believes are fungi. An uneventful recovery followed and a gradual improvement in the general condition. The blood elements showed a definite improvement. Numerous observations have been made in the dispensary since his discharge from the hospital. Six months after the operation he was readmitted, complaining of a pain in the right elbow. This was accompanied by a fever of 101°. The symptoms and the fever disappeared in forty-eight hours. A blood count at this time showed the hæmoglobin was 59 per cent.; red blood-cells, 3,680,000, and white blood-cells, 29,200; neutrophiles, 69 per cent.; lymphocytes, 30 per cent.; large mononuclears, 1 per cent.; polychromatrophiles marked; anisocytosis moderate. No megaloblasts found, three normoblasts found, while counting 100 leucocytes.

One year after the operation, the general appearance of the child was greatly improved and he had gained weight. The mother stated he had had only a few mild attacks of fever, and slight pains in the legs about once a month, but in general the symptoms in the attacks were much milder. There has been no recurrence of the pains in the abdomen. The child was observed in the hospital for two weeks and during that time was symptom-free and there was no fever. There was no appreciable change in the blood-picture from the examination made six months previous.

DOCTOR BOTHE remarked that it is hard to estimate just how much benefit the splenectomy is going to do this child. Though he has not been entirely

relieved of symptoms, the interval between the attacks is much greater in length, and the attacks are not so severe. The symptomatic improvement is apparent when contrasted with the untoward progress of symptoms as noted with each succeeding admission prior to operation.

Sickle-cell anæmia is a disease which is almost entirely limited to Negroes. In the past few years, however, Castana, Stewart, and Lawrence have all reported cases that have occurred in the white race. Two distinct conditions are known: (1) Sickle-cell trait, or sicklæmia, as suggested by Stewart; and (2) the active phase of sickle-cell anæmia. In patients showing the sickle-cell trait the red blood-cells will undergo transformation into the "oats" and "sickle" shapes in an anaërobic preparation. When the sickling occurs in the circulating blood and anæmia develops, it is considered the active phase. Patients who develop the active phase usually die before thirty years of age. Studies have shown that approximately 7 per cent. of all Negroes have the sickle-cell trait and a small percentage of this group develops the active phase. The cause for the sickle-cell formation is not known. Joseph believes it is due to a disturbance of hæmatopoiesis, in which the red blood-cells are effected so that they absorb an unknown substance common to all blood plasma which normal cells will not absorb. This substance remains attached to the surface of the cells, probably lowering the surface tension. It can be washed off in salt solution, after which the cells assume normal shape; when placed again in blood plasma, whether of a normal individual or of one possessing the sickle-cell trait, the abnormal forms reappear to the same extent as originally. The anæmia itself is due to hæmolysis and phagocytosis of the red blood-cells. The following is a brief description of the disease:

Symptoms.—The most constant symptoms are weakness and fatigue accompanied by fever. Pains in the extremities are common, and in many cases predominate. The most frequent locations of these pains are the upper end of the tibia and the vicinity of the ankle-joint. The classical symptomatology and local findings of acute osteomyelitis is not uncommon. Cases have occurred in which the differential diagnosis has been so difficult that caution should be used in operating upon Negro children until the blood has been studied to determine whether sickle-cell anæmia or a true osteomyelitis is the cause of the symptoms and local findings. In some cases severe pain in the epigastrium simulating an abdominal crisis is the outstanding symptom. Pain and stiffness in the muscles may occur. These patients are very prone to develop ulcers on the extremities even from minor traumas because of the lowered resistance. The fever is usually about 101° to 102°. These symptoms occur in attacks at about three- to six-week intervals and last from five to fourteen days.

The pathological changes present are so similar and so constant that it may be said that sickle-cell anæmia is a definite entity from the standpoint of pathological anatomy. The most significant pathological changes occur in the spleen and the bone-marrow. The capsule of the spleen is thickened. This organ is usually overfilled with blood, contains a large amount of pigment both iron-free and iron-containing. The trabeculæ are much more prominent than normally due largely to the atrophy and disappearance of the pulp. Many trabeculæ are found moderately impregnated with dense calcium. The Malpighian corpuscles are either small or have disappeared beyond recognition. The arterioles and capillaries are much congested. The sinuses are dilated and contain many bizarre forms of erythrocytes. Hæmosiderin granules can be found in clumps through-

out the section. Early in the disease there is a progressive enlargement of the spleen. In the later stages fibrosis occurs throughout the splenic pulp with resulting contracture in size and weight. Cases have been reported in which the spleen weighed less than fifty grams. There is a general lymphadenoid hyperplasia and a hyperplasia of the bone-marrow affecting both the red and white blood-cell elements. This is believed to be the result of some chronic injury to the bone-marrow with repair and compensatory hyperplasia.

Splenectomy was first suggested as the treatment for sickle-cell anæmia by Sydenstricker and Huck in 1924. They advanced the following indications for splenectomy: (1) Excessive hæmolysis; (2) compensatory activities of the hæmopoietic tissues evidenced by an excessive output of nucleated and reticulated red blood-cells and high white blood-cells; (3) splenomegaly; (4) evidence of splenic involvement by crises of abdominal pain. Since these observers have published their careful studies and the findings that they believe are indicative of splenectomy, greater interest has been stimulated in that form of treatment for sickle-cell anæmia.

It is generally believed that the spleen plays more than a minor rôle in this disease. Many more splenectomies have been performed in this condition than have been reported in the literature. From the meagre experience to date, with splenectomy in this form of anæmia, most observers feel that splenectomy should be performed early. Once fibrosis has occurred and the spleen has contracted, little or no benefit is to be expected. In the case just reported, the splenomegaly had persisted over a year, to our knowledge, and there was a fair degree of fibrosis throughout the splenic pulp. This may explain why the symptoms were considerably relieved, but a symptomatic cure was not obtained. Perhaps at a later date greater improvement may occur. Hahn and Gillisipe reported the first case in 1927, two years after operation, that was entirely relieved symptomatically. Subsequently, four cases have been reported in which the spleen has been removed. Two patients became symptomatically well, and in another case there was temporary relief. In one case the spleen had contracted, and at the time of removal weighed only forty-six grams. Though the symptoms are relieved, the sickle-cell trait persisted, just as the increased fragility of the red blood-cells persists, following splenectomy for congenital hæmolytic icterus though the disease has been symptomatically cured.

Dr. Ralph S. Bromer, by invitation, said that the question might be asked whether the prominence in this child's skull, posterior to the anterior fontanelle, could be due to rickets, inasmuch as other clinical signs of rickets were present. In rickets, the so-called bosses occur most frequently in the frontal area. This prominence is due to thickening of the outer table, but nowhere can any so-called perpendicular striations be seen. In the congenital anæmias of childhood, especially the Cooley type, such striations are seen arising from the outer table and also are seen connecting the outer and inner tables. Striations connecting the outer and inner tables are found in normal individuals as pointed out by Pancoast and Sosman. Perpendicular striations

extend outward from the outer table and inward from the inner, in cases of meningioma. These points are essential in the differential diagnosis. Many case reports of sickle-cell anæmia mention the fact that no bone changes were present. It seems it can be taken for granted in this case that the thickening and raising up of the outer table are due to the anæmia but the process has not advanced to the stage of perpendicular striations as found in the cases of erythroblastic anæmia as described by Cooley.

Dr. George P. Muller said that in September, 1926, he did a splenectomy for this condition in an octoroon boy. At the time of operation the spleen was exceedingly small; the case was reported later by Stewart, in 1927. At the time they were skeptical of the value of the splenectomy as the spleen had gone on to complete fibrosis. This boy was studied in 1931, is perfectly well, has grown, but still has anæmia, 54 per cent. hæmoglobin, 2,000,000 red blood-cells and sickle cells.

Doctor Bothe said that the finding of a hypernephroma in a patient so young is unusual, although they are occasionally reported under ten years of age. The location is very unusual. Adrenal rests of the liver have been reported as well as primary hypernephromata, the former very much more frequent. The speaker knows of no case of primary hypernephroma of the liver in early infancy. Unless one studies this tumor closely, histologically it might easily be interpreted as a mixed tumor. The cells, however, are of the same type throughout. They appear as those found in the zona fasicularis of the adrenal. The areas in which the cells appear to be in acinar arrangement are probably due to a tubular-like placement, cut in cross-section, or a centralized liquefaction necrosis. The precocious development of the genitalia is in accord with adrenal tumors.

TUMOR OF THE LIVER OF ADRENAL ORIGIN

Dr. James B. Mason and Dr. John Speese reported the case of a white boy of seventeen months, who was admitted in the service of Dr. John H. Gittings, at the Children's Hospital, February 2, 1926, with the chief complaint of severe upper abdominal pain, and high fever (103° F.). These symptoms had developed suddenly one week before admission, and with but slight remissions had persisted. There was no vomiting or diarrhœa. There was a negative family history and the past medical history was without incident except for an episode of acute gastro-enteritis in November, 1925. The infant was very anæmic. The abdomen was distended and showed an area of ecchymoses about the umbilicus. Palpation revealed a hard, irregular, tender mass in the left hypochondrium, which did not move with respiration, was not continuous with the spleen, and which extended downward and laterally apparently toward the left kidney.

There was a negative urinalysis. The blood studies showed a marked secondary anæmia. The blood Wassermann was negative. Three days after admission a transfusion of 175 cubic centimetres of citrated blood was given. Five days after admission the leucocytes were 18,900, and the hæmoglobin had decreased to 26 per cent. and erythrocytes were 2,510,000. One week after admission the patient was transferred to the surgical service of Dr. John Speese.

February 9, 1926, Doctor Speese performed a laparotomy. A vascular tumor the size of a large orange was discovered attached to the under surface of the right lobe

of the liver, just to the right of the mid-line. The tumor was encapsulated and was removed with ease. Further exploration revealed no other abnormalities. Immediately after operation the patient was given a transfusion of 115 cubic centimetres of citrated blood. Except for a mild pulmonary complication the convalescence was without incident and the patient was dismissed on the fourteenth post-operative day.

The tumor was an orange-sized fibrotic, vascular tumor, which cut without gritty sensation and which exuded blood from the cut surfaces. In none of the sections of the tumor were liver cells or bile passages demonstrable. There were frequent areas of hæmorrhage and of degenerative changes following hæmorrhage, with overgrowth of fibrous tissue, and presence of hæmosiderin. Indeed, it was a gross hæmorrhage into the tumor which provoked the acute symptoms. However, there were present in the tissue three distinct areas, with as many different histological pictures. There were groups of highly vacuolated cells in irregular cord formation, similar in size, arrangement, and inner structure to those of the Zona Fasiculata of the adrenal gland. The second type of cytology was represented by nests of basophilic staining cells, similar in appearance to the cells found in the Zona Glomerulosa of the adrenal. The third type of abnormal structure found in this tissue was acini-like areas mostly without cell lining, sometimes, however, lined by cuboidal cells in a single layer, while in other areas the lining was of many layers. The majority of these acini were filled with eosin staining colloid or hyaline material. They did not resemble thyroid acini or acini of any particular organ. Also, there were numerous areas of this hyaline-like material which greatly resembled decalcified bone in appearance. On careful study it became apparent that the hyaline-like material could be observed in which one could faintly distinguish outlines of erythrocytes. Although there were occasional mitotic figures present, complete differentiation of the cellular elements suggested a benign tumor or one of very low-grade malignancy. The result of this histopathological study revealed that a primary tumor of the liver of adrenal rest origin, either benign or of very slight degree of malignancy, had been encountered.

The child was under observation for seven months after operation, and gave no evidence, either clinical or by X-ray, of recurrence or metastases. The patient was not seen in the medical dispensary until January 3, 1931, when he returned because of a three months' history of a harsh, deep voice, and progressive symptoms of sexual precocity. He presented enlargement of the bones of the face and the extremities. There was a considerable growth of pubic hair and the genitalia were much over-developed. He weighed seventy-one pounds. He was admitted to the hospital on Doctor Speese's service for further study. Urinalysis was negative. Blood count was normal and blood-chemistry studies were within normal limits. The blood serology was negative. X-ray studies were negative for metastases to the long bones or spine. The skull showed a small sella turcica, and a marked density in the right antral region. The patient was dismissed with a diagnosis of hypernephroma, unimproved.

He developed chickenpox in March, 1931, and two weeks later was admitted to the Temple University Hospital with a chief complaint of marked pains in the back and all four extremities. X-ray examination revealed a small sella turcica, right maxillary antrum filled with soft tissue material, and no evidence of a pineal tumor. The child was admitted to Tumor Clinic of the Jewish Hospital, May 18, 1931. Metastatic lesions were found in the spine, left lung, ileum, and right femur. The conclusion was that the multiple bony metastases and the chest metastasis were from a malignant neoplasm, probably hypernephroma.

The right nasal cavity was occluded by a hard growth, which extended towards the infraorbital region. While in the hospital the child ran a very irregular temperature, varying from 108° F. to 96° F. Analyses of urine and blood, except for moderate secondary anæmia, were not abnormal. The child grew progressively worse and died June 6, 1931. Post-mortem was not permitted. A final diagnosis of hypernephroma with metastases to bone was made.

The reporter referred to a paper by Doctor Bothe in 1926, in which were discussed theories of adrenal rests and tumor formation. In a study on the sixteen-millimetre human embryo, he noted the juxta-position of the anlagal cells of the suprarenal with the primitive cell masses of the liver, kidney, ovary, testicle, epididymis and uterus. He concluded that "one can easily see the possibility of adrenal inclusions in any of these organs." Bothe further presented evidence that primary hypernephroma may develop in any tissue or organ which is the seat of adrenal rests, and he tabulated cases of primary hypernephroma of the liver by Adami and McCrae, Rolleston, Schmorl, Vecchi and Noyes. Recent case reports by Abell and Ramsey give further evidence to his contention for this organ. When hypernephroma occurs in children sexual precocity is frequently encountered. Goldzieher drew attention to this phenomenon in young girls, and pointed out that cortical adrenal hyperplasia, or the presence of adrenal tumors or hypernephroma, were the causative factors. In boys he believed that pineal tumors, or testicular teratomas were responsible for sexual precocity in more instances than were adrenal tumors. There are numerous case reports in the recent literature by Schweizer, *et al.*, Orru, Harris and Plewes, and Ismail, who present cases of sexual precocity in children, due to suprarenal tumors in one locality or another. That sexual precocity does not develop in all instances of adrenal tumors, testicular teratomas or pineal tumors, Goldzieher stated in explanation that many of these tumors are rapidly growing, and that the patient succumbs to the malady before the anatomical changes incident to sexual precocity have had an opportunity to develop. In this case, it is apparent that the pathological phenomenon which brought the patient to the hospital, and allowed the surgeon to discover a neoplasm of the liver, was the occurrence of a hæmorrhage into the tumor, with the production of pain and fever. That the primary tumor was of adrenal origin rests upon a sound cytological basis, but that it was truly benign or of a low grade of malignancy is less definite. The complete differentiation of cells of the tumor, the presence of a capsule, and the period of nearly five years of good health speaks for benign neoplasm. The question naturally presents itself—was death due to a slow-growing remnant of the primary tumor or was there an independent recent growth of greater malignancy—probably hypernephroma? It is suggested that this latter opinion is likely correct.

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DR. RALPH S. BROMER, by invitation, remarked that metastases in hypernephroma are more usually of the hypoplastic type and not of the hyperplastic type, as in this case. Here the periosteum seems to be raised up but there are no perpendicular striations so often seen in malignant lesions of bone. The appearance is more like that of the lace-work type of periosteal change observed in syphilis of bone. From the röntgenograms alone, without knowing the history of the case, it would be impossible to make a diagnosis. Several years ago, in a case of neurocytoma primarily located in the adrenal, observed at St. Christopher's Hospital for Children, metastatic lesions in the long bones were found, but, although they were hyperplastic in type and seemed to affect the periosteum for the most part, yet typical perpendicular striations were present. The shadow in the mediastinum in the chest films of this case, apparently due to metastasis, very much resembles a mediastinal mass of tuberculous glands. The changes in the vertebral bodies, wedge-shaped deformities, but with complete preservation of the intervertebral spaces, would rule out tuberculosis as a cause of the osseous lesions. The presence of the hyperplastic type of metastasis in this case of adrenal tumor and also in the neurocytoma just mentioned, seems to suggest that in adrenal tumors of childhood the prevailing type of metastasis is hyperplastic in character, while in cases of hypernephroma in adults, the opposite seems to be the more usual finding.

DR. WALTER E. LEE said that the association of precocious sexual development in patients with adrenal tumors has recently been reported from a number of clinics in this country. There are two rather unusual cases in Philadelphia at the present time. The one at the Germantown Hospital, under the care of Doctor Swartley, is thirty-five years of age. She has been married nine years as a wife but she anatomically is male. The other, at the Pennsylvania Hospital, is fourteen years of age with all the characteristics of a boy, with the hair so well developed that it is necessary to shave three times a week. The voice is a deep bass. The external genitalia are abnormal. There is a clitoris which is large enough to be mistaken for a penis, the hymen is imperforate and there has been some suggestion of menstruation. This patient was operated upon because on rectal examination a tumor in the pelvis was thought to be an enlarged ovary. On examination, perfectly normal female pelvic organs were found, uterus, tubes and ovaries. The kidneys were palpated but apparently were in normal position and of normal size and there was no enlargement of the upper pole suggesting tumors of either adrenals.

BLADDER INJURY FOLLOWING WOUNDS IN THE THIGH

Dr. Alexander Randall reported the case of a man aged thirty-three, who, while hunting on December 5, 1931, was in a crouching position, ready to shoot, when a stranger fired in his direction. They both were stalking the same deer from different approaches. Immediately following the report of this gun he felt an impact on the outer middle third of the left thigh. Having been wounded in the opposite leg, during the last war, he realized that he had been shot; but soon finding that his locomotion was not involved, nor any pain experienced, he made his way back to his companions, and from thence to his home. The wound of entrance was found, but there was no evidence of hæmorrhage or foreign body, and a simple dressing was followed by a prompt primary union. An X-ray failed to show the missile in the leg, but a picture of the pelvis depicted it in what was thought to be the muscles of the buttocks. A few days later, experiencing increasing difficulty at urination, but without having observed the slightest amount of hæmaturia, he was cystoscoped and a round ball was seen to be lying free in the bladder cavity. There was a slight amount of ecchymosis on the left lateral wall, but without evidence of perforation or any urinary extravasation. January 6, 1932, with a cystoscopical rongeur, it was possible to grasp the foreign body and withdraw it through the urethra in the beak of the instrument. When examined it was found to be slightly encrusted with phosphatic salts and to be a caribou buckshot. The patient's recovery was uncomplicated.

The only inconvenience that this foreign body created in the bladder, which it unquestionably entered at the time of the original wounding, was the blockage of the internal vesical orifice at urination. At the time of the removal of the buckshot, the only evidence at the point of entrance into the bladder was a punctate scar on the left lateral wall about three to four centimetres above the ureteral orifice. There was still one slight ecchymotic spot visible.

TRAUMATIC PERFORATION OF URINARY BLADDER WITH RETENTION OF WOOD SPLINTERS

Doctor Randall reported the case of a boy aged eleven, who was admitted to the hospital May 4, 1929. Five years before, the patient fell off a porch into a hedge and fencing, at which time a splinter of wood entered the left thigh on the inner aspect of the lower third. An attending physician pulled out a long splinter of wood and applied a local dressing, and three days later the infected wound required hospitalization and dressings. One month after the accident, an abscess formed in the region of Scarpa's triangle. This was incised and pus and urine evacuated. Following this incision, urine continued to dribble from this fistulous orifice. The patient was then cystoscoped and a rent observed in the left side of the bladder. A cystotomy was performed and the wound in the left lateral wall of the bladder sutured. Following this the fistula in the thigh closed for a month and normal urination was temporarily established. Then the abdominal incision broke down and became a urinary fistula. Six months later, the fistula in the thigh likewise reappeared. During the past five years urine has passed through both fistulous orifices and the urethra, while the boy has been of necessity kept from school, play and his normal activities.

Study of this case, five years after the accident, revealed the following condition: There was a patent suprapubic fistula discharging urine, and a second urinary fistula over Scarpa's triangle; the course of the wood splinter from the point of entrance to the fistula in the thigh had apparently been healed a number of years. Mild urinary sepsis existed, though the blood urea never exceeded thirteen milligrams to the 100 cubic centimetres. Study by cystograms failed to show any extravasation from the bladder, though marked regurgitation up the urinary tract occurred. There appeared to be a complete breakdown of the uretero-vesical sphincters with marked dilatation of both ureters and renal pelves. Cystoscopy revealed an unhealthy scar in the left lateral

bladder wall. Injection of the fistula in the thigh, followed by stereoscopic plates, demonstrated beyond question that the fistulous tract led through the obturator foramen and the injected material appeared not only in the bladder but again regurgitated up either ureter. Operation, May 20, 1929, found a small contracted bladder with an ulcerated orifice on the left lateral wall leading out into the cellular tissues in the left side of the pelvis. A probe passed into the thigh fistula found its way into this ulcerated bladder lesion. Extravesical exposure led down to an unhealthy cavity from which *four large splinters of wood*, still retaining their green paint, were removed. They were of similar length, measuring 7 centimetres and varied in thickness from that of a match stick to four times this size. The sinus was thoroughly curetted and a rubber tube and gauze pack placed from the fistulous opening in the thigh to the peri-vesical area. The wall of the bladder was freshened about its borders and closed with interrupted catgut sutures. The bladder was closed about a mushroom catheter drain. The patient made a slow recovery from this operation, and on June 3, 1929, the thigh fistula appeared to be healed, and on June 25, 1929, a bladder examination, obtained by passing the cystoscope into the suprapubic fistula, apparently showed the bladder wall likewise healed. Drainage was then removed from the suprapubic fistula, and the same allowed to heal. Incontinence developed with the closure of the sinus and though the patient appeared to have voluntary control of bladder emptying, nocturnal incontinence was the rule. With this development, both suprapubic and thigh fistulæ again opened spontaneously on July 3, 1929. The suprapubic wound was opened and a débridement of the fistulous tract to the thigh, followed by a tight gauze pack, was performed. On August 23 he was discharged, in care of his physician, with a permanent suprapubic mushroom catheter. With the continued closure and apparent permanent healing of the thigh fistula, his suprapubic tube was removed during the middle of December, 1929, and the patient reported for observation January 26, 1930. His thigh fistula appeared strongly healed, while the suprapubic one was rapidly closing. A cystoscopical examination January 29, 1930, showed a small bladder with a healthy mucous membrane and a healthy scar on the left lateral wall. Both ureteral orifices were visualized and found to be gaping open. The suprapubic fistula was severely curetted and cauterized with the intention of allowing it to heal. During this stay in the hospital, two studies by means of uroselectan were performed. They both showed a bilateral hydronephrosis and hydroureter, in spite of which a blood-urea estimation of eighteen milligrams was recorded, and a phthalein output of 40 per cent. February 12, 1930, his suprapubic fistula closed and normal voiding was obtained at two- to three-hour intervals by day, though at night incontinence was the rule. He was discharged on March 16, 1930. He was re-admitted to the hospital June 13, 1931, at which time his suprapubic wound was reported as being well healed. A Caulk's cautery punch operation was performed with the idea of correcting a congenital stenosis of the internal sphincter as a possible cause of persistent back pressure on the bladder and upper urinary tract. This operation was performed June 17, 1931, and his recovery was uncomplicated; since which time a follow-up examination September 12, 1931, showed both fistulæ to remain permanently healed, and though the child has normal voluntary urinary control by day, nocturnal incontinence is still troublesome. Final observation on the patient, the first week of March, 1932, showed both fistulæ to be strongly healed, and there has been no leakage since the last report. He has grown in strength and is attending school, though probably slightly under size for his age.

SALIVARY CALCULI

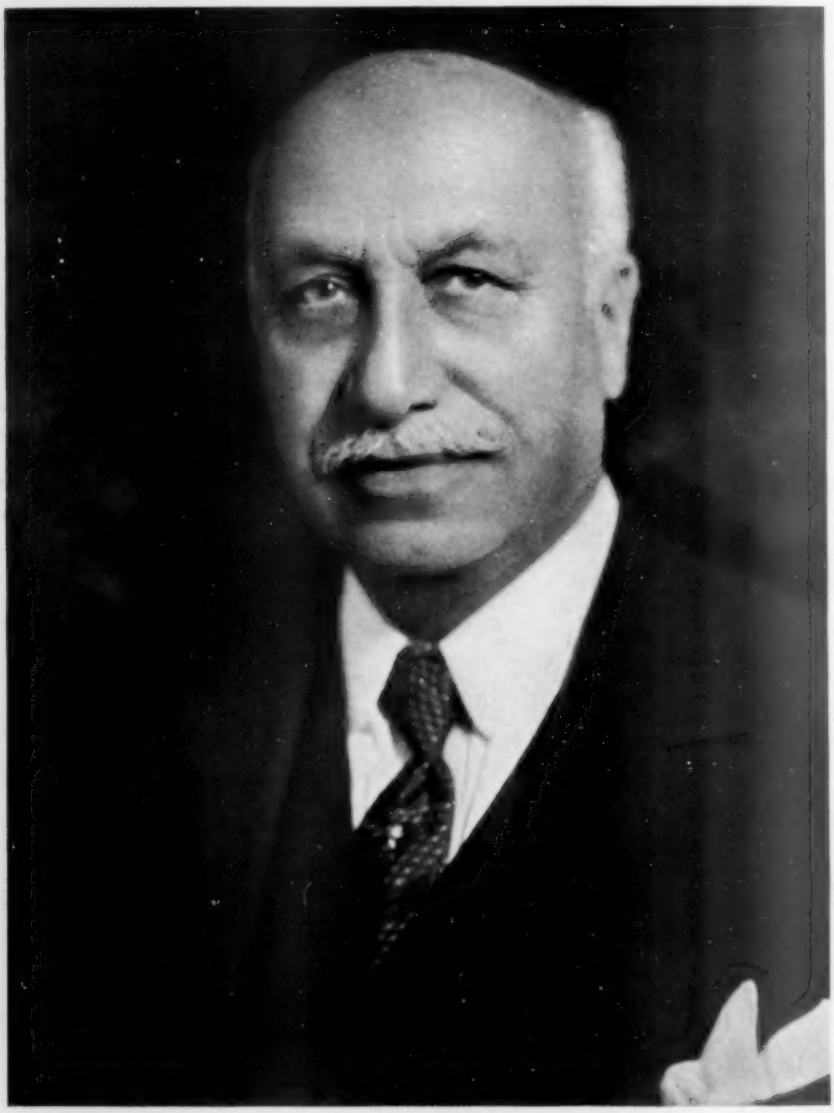
DRS. ROBERT H. IVY and LAWRENCE CURTIS read a paper, Salivary Calculi, for which see ANNALS OF SURGERY, December, 1932, p. 979.

MEMOIRS

WILLY MEYER, M.D.

1858–1932

WILLY MEYER was born at Minden, Germany, July 24, 1858. He studied at Bonn, then at Erlangen, and in 1880 took his M.D. at Bonn. After a military service as voluntary surgeon he became Assistant in the Surgical Clinic



WILLY MEYER, M.D.

of the University of Bonn, which position he held for three years, in the last of which he was First Assistant.

Trendelenburg was then Chief of the Clinic. Young Meyer assisted him in many operations during those years in which the method of elevating the patient's pelvis in the performance of certain pelvic and abdominal operations was worked out and thoroughly tested by Trendelenburg, who, in 1884, entrusted to Meyer the first publication of that posture which subsequently became universally known as Trendelenburg's posture. A friendship developed between the two men which lasted up to Trendelenburg's death.

Doctor Meyer came to New York in 1884. Two years later he was appointed Professor of Clinical Surgery at the Woman's Medical School, Attending Surgeon to the New York Skin and Cancer Hospital and to the German Hospital, now known as the Lenox Hill Hospital, and in 1887 to the Post-Graduate Hospital.

In 1923, having reached the age limit, he continued his connection with these institutions in the capacity of Consulting Surgeon. The New York Infirmary for Women and Children, the Hospital for Joint Diseases, the Montefiore and the Glens Falls Hospitals also had him on their Consulting Staffs for many years.

He introduced into this country the results of investigations by a number of European physicians, thus cystoscopy in 1887, catheterization of the ureters in the male in 1896, Bottini's operation for hypertrophy of the prostate gland in 1897, and modern methods of gastrostomy in 1894 to 1896.

Thoracic surgery became one of his favorite studies in 1904, with especial attention to the negative-pressure cabinet introduced by Mikulicz and Sauerbruch. After experimental studies with a cabinet at the Rockefeller Institute he caused a most perfect cabinet and outfit for all varieties of differential pressure to be constructed at the German Hospital, which was doubtless the finest plant of this nature in existence. Thoracic surgery in America owes a great deal to Meyer's pioneer work. In his clear vision of the importance of this specialty he founded in 1919 the New York Society for Thoracic Surgery and the American Association for Thoracic Surgery.

In 1894, after Heidenhain had shown that in carcinoma of the breast an involvement of the pectoral muscles was very common, he studied this phase with intense interest, elaborating and improving the then existing methods of operation, and published his method of a more radical operation for cancer of the breast, a method with which his name is connected in the literature on that subject. His interest in cancer and his extensive study of the literature on cancer are best evidenced in his last publication, a book entitled "Cancer," in which he comes to the conclusion that cancer is a systemic disease.

Among his publications, those on thoracic surgery are probably the most numerous, but he has been a prolific writer on many other subjects.

He was a Fellow of the American College of Surgeons, a member of the American Medical Association, American Surgical Association, American Thoracic, Gastro-Enterological and Urological Associations, American Association for Cancer Research, New York County and State Medical Societies,

New York Academy of Medicine, New York Surgical Society, Pathological Society, Deutsche Gesellschaft für Chirurgie, and Deutsche Gesellschaft für Urologie.

Not satisfied with the performance of routine surgery, he was an ardent student of medical literature and was eager to grasp and accept anything that impressed him as being a valuable addition or improvement in surgical procedure. His enthusiastic advocacy of what he considered good and worth while was always inspiring and often convincing.

He loved to teach, and many house staff members who worked under him appreciate how much they owe to the instruction received from Doctor Meyer as he entered into discussions with them on the minutest details in any case under his treatment.

He will always be remembered as a sincere seeker for truth in medical science and as a diligent worker in its propagation. In the furthering of any task he had undertaken he was often referred to by his friends as being a "live wire," on account of the great energy he displayed. This devotion to a purpose served as a stimulus to many who had the good fortune to observe his work. Through his personal charm he made many friends, and through his earnest efforts in the cause of medical science he gained universal respect.

He had the good fortune to work in his chosen path to the very last hour, for, when he died, February 24, 1932, it was shortly after the end of a meeting of the New York Surgical Society, at which he had taken part in a discussion on cancer of the breast.

FRANZ TOREK

EMORY GRAHAM ALEXANDER, M.D.

1880-1930

EMORY ALEXANDER died in Philadelphia on August 29, 1930. He was born in Charlotte, North Carolina, in 1880. He received his preliminary education at the University of North Carolina and graduated from the Jefferson Medical College in 1904. His ancestors, both the Alexanders and Grahams, have been conspicuous in the history of the country since Colonial

EMORY GRAHAM ALEXANDER, M.D.

days. On graduation Doctor Alexander became an intern at the Episcopal Hospital of Philadelphia. On completing his service, he took up the teaching and practice of surgery. He was closely associated with Dr. H. C. Deaver, one of the surgeons of the Episcopal Hospital. Among his subsequent teaching positions were: Demonstrator of Fracture Dressings at the Jefferson Medical College; Clinical Professor of Surgery, Women's Medical College, and Clinical Professor of Surgery at the University of Pennsylvania.

The last position, and that of Attending Surgeon of the Episcopal Hospital, he held at the time of his death.

In addition to his Fellowship of the American Surgical Association, he was a Fellow of the Philadelphia Academy of Surgery, of the College of Physicians of Philadelphia and of the American College of Surgery.

Doctor Alexander made numerous contributions to surgical literature usually through the medium of the Academy of Surgery.

During the late war he served as one of the surgeons of a Base Hospital in France with the rank of Major.

Doctor Alexander's success, which began at an early period in his professional career, was due to his skill, his judgment and his enthusiasm.

Doctor Alexander married the daughter of Dr. John B. Deaver, who survives him.

JOHN H. GIBBON.
PHILADELPHIA, PA.

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